60

THE RESOURCES AGENCY OF CALIFORNIA

Department of Water Resources

BULLETIN No. 39-60

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

VOLUME I

TEXT

DECEMBER 1961

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Administrator
The Resources Agency of California
and Director
Department of Water Resources

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

BULLETIN No. 39-60

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

VOLUME I
TEXT

DECEMBER 1961

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Administrator
The Resources Agency of California
and Director
Department of Water Resources

VOLUMES OF BULLETIN No. 39-60

Volume I—Text.

Volume II—Precipitation and Water Level Data, Central Coastal, and Los Angeles Regions.

Volume III—Precipitation and Water Level Data, Lahontan, Colorado River Basin, Santa Ana, and San Diego Regions.

TABLE OF CONTENTS

CHAPTER III. GROUND WATER SUPPLY CONDITIONS

CHAPTER IV. QUALITY OF WATER AND SEA-WATER INTRUSION

TABLES

TABLES

PLATES

(Plates listed below are bound at the end of this volume)

PLATES

(Plates listed below are bound at the end of this volume)

APPENDIXES

WILLIAM E. WARNE
Director of
Water Resources

JAMES F. WRIGHT
Chief Deputy Director

B. ABBOTT GOLDBERG
Deputy Director—Contracts

REGINALD C. PRICE
Deputy Director—Policy

ALFRED R. GOLZÉ
Chief Engineer

EDMUND G. BROWN
GOVERNOR OF
CALIFORNIA

WILLIAM E. WARNE
ADMINISTRATOR
RESOURCES AGENCY

ADDRESS REPL
P. O. Box 388
Sacramento 2,

THE RESOURCES AGENCY OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

1120 N STREET, SACRAMENTO

December 18, 1961

Honorable Edmund G. Brown, Governor, and
Members of the Legislature of the
State of California

Gentlemen:

I have the honor to transmit Bulletin No. 39-60, "Water Supply Conditions in Southern California during 1959-60". As the most recent in a series of annual reports, the bulletin was prepared pursuant to Sections 225 and 226 of the California Water Code.

During the report period, precipitation was again generally below normal throughout the area. In coastal regions, precipitation was approximately 70 percent of mean, and major stream runoff amounted to about 28 percent of mean.

Continuation of the drought has also meant that the supply of water available in the area has diminished. This is evidenced by a decrease in the amount of water stored in surface reservoirs (down to 18 percent of capacity on October 1, 1960, from 23 percent of capacity a year earlier), a general lowering of ground water levels, and a rather marked increase in the volume of water imported.

The Metropolitan Water District of Southern California and the City of Los Angeles imported an all-time high of 1,158,000 acre-feet of water through their aqueducts. This represents a 16 percent increase over their importations of water in the previous year.

Despite such large increases in volume of imported water, ground water levels continued to decline. Consequently, sea water continued to intrude ground water basins in coastal areas, degrading water quality in portions of those basins. Rather large advances of intruding sea water were noted in the ground water basins in the Oxnard Plain of Ventura County and the Coastal Plain of Orange County.

In view of the extent and complexity of water supply problems discussed in this bulletin, those programs which seek to alleviate or solve such problems appear to warrant continued attention and support.

Sincerely yours,

William E. Warne

Director

ACKNOWLEDGMENT

The Department of Water Resources gratefully acknowledges the assistance and contributions of the many public agencies, private organizations, and individuals whose cooperation greatly facilitated the preparation of this bulletin. In this regard, special mention is made of the following:

City of San Bernardino

City of San Diego

Los Angeles County Flood Control District

Los Angeles Department of Water and Power

Orange County Flood Control District

Riverside County Flood Control and Water Conservation District

San Bernardino County Flood Control District

San Luis Obispo County Flood Control and Water Conservation District

The Metropolitan Water District of Southern California

United States Geological Survey

United States Weather Bureau

United Water Conservation District

Ventura County Flood Control District

Eleventh Naval District, Public Works Office

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

EDMUND G. BROWN, Governor
WILLIAM E. WARNE, Administrator, The Resources Agency of California and Director, Department of Water Resources
ALFRED R. GOLZE, Chief Engineer

SOUTHERN DISTRICT

Herbert A. Howlett . . . . District Engineer
Lloyd C. Fowler . . . . Chief, Planning Branch

This bulletin was prepared
under the direction of

Donald H. McKillop . . . . Senior Engineer, Water Resources

by

Robert F. Clawson . . . . Senior Engineer, Water Resources

assisted by

Walter Tilton . . . . Assistant Civil Engineer
Sydney A. Zucker . . . . Assistant Civil Engineer
Harold W. Leeson . . . . Assistant Civil Engineer
H. P. Zablodil . . . . Senior Delineator

Chapter IV of this report
was prepared under the direction of

David B. Willets . . . . Supervising Engineer, Water Resources

by

Robert Fox . . . . Associate Engineering Geologist

---

CHAPTER I. INTRODUCTION

This report is the twenty-ninth of the Bulletin No. 39 series which has been published annually since 1932. The report contains a discussion of water supply conditions in Southern California for the 1959-60 season, with supporting basic data compiled by the Department of Water Resources and other water agencies operating in Southern California. Presented in this report are data on precipitation, surface stream flow, and underground waters, including consideration of both quantity and quality of these resources. Information is also given on the activities of representative water agencies. This material is intended for the use of water agencies and the public in the study of surface and ground water problems.

Authorization

The California Legislature of 1929 enacted legislation designated Chapter 832, Statutes of 1929, quoted in part, as follows:

> "SECTION 1. Out of any money in the state treasury not otherwise appropriated, the sum of four hundred fifty thousand dollars*, or so much thereof as may be necessary, is hereby appropriated to be expended by the state department of public works in accordance with law in conducting work of exploration, investigation and preliminary plans in furtherance of a coordinated plan for the conservation, development and utilization of the water resources of California including the Santa Ana river and its tributaries, the Mojave river and its tributaries, and all other water resources of Southern California."

* Reduced by the Governor to $390,000.

Pursuant to this legislation the Division of Water Resources undertook a series of hydrologic investigations of the Southern California area. Subsequent sessions of the Legislature provided funds for the Division of Water Resources and later, the Department of Water Resources, to continue

these studies. Initially, this included some investigation of the quality of irrigation waters; however, pursuant to Chapter 1552, Statutes of 1949, this work was expanded to include the study of pollution and degradation of waters of the State. Current authorization for this work is set forth in Sections 225 and 226 of the California Water Code.

Scope of Activity and Report

The early reports of the Bulletin No. 39 series were limited to publication of ground water level records in the Santa Ana, San Gabriel, and Los Angeles River Valleys, and the West and South Coastal Plains. Subsequently, the area covered by the report was extended to include the San Jacinto and Antelope Valleys. A general water supply summary for the southern portion of the State was added in 1948. The summary contained information on precipitation, runoff, surface reservoir storage, importations, water quality, and changes in ground water levels.

To enable more rapid dissemination of data, the period covered by the reports was changed in 1956 from the calendar year to the water year (October 1-September 30), or precipitation year (July 1-June 30), as the data permitted, and the area was expanded to include the entire Southern District encompassing the area shown on Plate 1, "Location of Southern District". In addition, discussions of sea-water intrusion, weather modification operations, outflow to the ocean, and sewage discharge to the ocean were added to provide a more complete description of water supply conditions.

Bulletin 39-60 is presented in three volumes. This first volume contains a description of the water supply conditions during the 1959-60 season, while Volumes II and III consist of six appendixes containing ground water level data. Sixteen pertinent plates are bound in Volume I.

Volume II contains Appendix A, "Records of Ground Water Levels at Wells in Central Coastal Region (No. 3)"; and Appendix B, "Records of Ground Water Levels at Wells in Los Angeles Region (No. 4)". Volume III contains Appendix C, "Records of Ground Water Levels at Wells in Lahontan Region (No. 6)"; Appendix D, "Records of Ground Water Levels at Wells in Colorado River Basin Region (No. 7)"; Appendix E, "Records of Ground Water Levels at Wells in Santa Ana Region (No. 8)"; and Appendix F, "Records of Ground Water Levels at Wells in San Diego Region (No. 9)".

Methods and Procedures

The use of machine data handling procedures facilitated preparation of the appendixes to this report. Ground water level data were placed on IBM cards and listed by use of a tabulating machine. In connection with this procedure it was necessary to adopt a coding or numbering system to designate ground water basins, precipitation stations, and wells. These coding systems are described in the following paragraphs.

Areal Designation Code

The areal designation code is based on a decimal numbering system using the form 0-00.00, although in the appendixes of this report machine limitations have required the shortening of this to the form 00000. The number to the left of the dash refers to the geographic region as defined in Section 13040 of the California Water Code and delineated on Plate 1. The two digits to the left of the decimal point refer to a hydrologic unit. This unit generally comprises a major watershed, which may include areas overlying both water-bearing and nonwater-bearing formations. For simplification, the designation "hydrologic unit" is also given to groups

of small adjacent watershed areas, with similar hydrologic conditions, which drain directly to the ocean. The Malibu Hydrologic Unit is an example of this type of watershed area.

The two digits to the right of the decimal point refer to a subunit within the hydrologic unit, including, as before, areas overlying both water-bearing and nonwater-bearing formations. The locations and numerical codings for the hydrologic units and subunits within the area treated in this report are shown on plates pertinent to Chapter III. Similar plates are also provided in Volumes II and III of this bulletin.

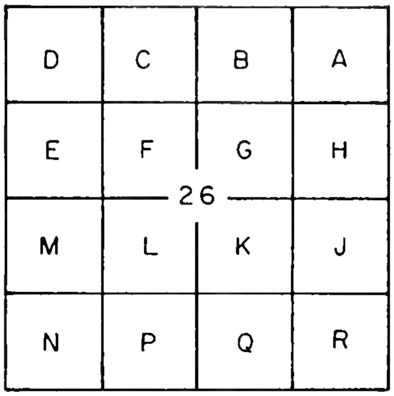
Precipitation Station Designation

Precipitation stations are designated by their longitude and latitude to the nearest second. This gives the location of the station within an accuracy range of about 100 feet.

Well Numbering System

The well numbering system employed herein is that originated by the United States Geological Survey and is referenced to the township, range and section subdivision of the Federal Land Survey. It conforms to that used in all ground water investigations made by the United States Geological Survey in California and has been adopted by the Department of Water Resources. A cross-index between this numbering system and systems in common use by other agencies in the Southern California area was published as Volume IV of Bulletin 39-57.

Under the adopted system each section is divided into 40-acre plots, called lots, which are lettered as follows:



Wells are numbered within each of these lots according to the sequence in which they have been assigned State Well Numbers. For example, a well which has the number 10N/18E-26A1, S would be in Township 10 North, Range 18 East, Section 26, San Bernardino Base and Meridian, and would be further located as the first well assigned a State Well Number in Lot A. In this report, well numbers are referenced either to the San Bernardino Base and Meridian (S) or the Mount Diablo Base and Meridian (M).

For some wells, the letter following the section number is designated "X". This indicates that the well has been field located and accurately plotted with respect to its position on the map; however, the map control for the Public Land Survey in that area at present is inadequate and does not warrant assignment of a more accurate location number.

Definition of Seasons

Reference is made to a number of periods or seasons in the description of water supply conditions presented in the ensuing chapters of this report. Since the time span for each of these periods or seasons depends upon the type of data being accumulated, the periods are defined in the following paragraphs.

Precipitation

Precipitation data covers the 12-month period July 1 through June 30. This conforms to standard United States Weather Bureau practice. Because of local practice, sewage disposal data are also related to this period.

Surface Runoff

Surface runoff data are compiled for the water year, which comprises the 12-month period, October 1 through September 30. Artificial recharge and imported water data are also related to this period.

Reservoir Storage

The quantity of water in storage in surface reservoirs is given as of October 1 of each year.

Ground Water Levels

The appendixes to this report contain water level data for the period July 1, 1959, through June 30, 1960. However, for purposes of the discussion of water supply conditions, ground water level data are generally related to the period spring to spring. This generally approximates the period April 1959 to April 1960 and the average changes in ground water levels are compiled by arithmetically averaging data obtained at both of these times. This period is used since about one-half of the wells are measured on a semiannual basis in the spring and in the fall, and the most uniform coverage can be obtained at these times. Since all ground water data collected by local agencies were obtained by the Department during the summer, the spring measurements were selected for annual comparisons in an endeavor to make this report as current as possible. In a few

instances, particularly when only annual measurements are collected, some other period corresponding to the field measurements is referred to. Where such deviations are made, appropriate notes are provided.

Contemporary Basic Data Reports

This report is one of several related reports issued annually by the Department of Water Resources, designed primarily to publish basic hydrologic data and to present discussions of water supply conditions. Concurrent reports, not all of which are published annually, are listed below. The year indicated in the title is that of the latest publication.

Bulletin Series No.	
23	Surface Water Flow for 1959 (Formerly Sacramento-San Joaquin Water Supervision)
65	Quality of Surface Waters in California; 1957-58
66	Quality of Ground Waters in California; 1957-58
77	Ground Water Conditions in Central and Northern California, 1957-58
91-1	Data on Wells in the West Part of the Middle Mojave Valley Area, San Bernardino County, California; June 1960
91-2	Data on Water Wells and Springs in the Yucca Valley - Twentynine Palms Area, San Bernardino and Riverside Counties, California; June 1960
91-3	Data on Water Wells in the Eastern Part of the Middle Mojave Valley Area, San Bernardino County, California; August 1960
91-4	Data on Water Wells in the Willow Springs, Gloster, and Chaffee Areas, Kern County, California; September 1960
91-5	Data on Water Wells in the Dale Valley Area, San Bernardino and Riverside Counties, California; March 1961

In addition, water condition reports are prepared by the Department of Water Resources as of the first of each month from February through May of each year. They contain forecasts of the runoff expected to occur during the ensuing April-July snowmelt period. The April 1 reports contain a section on ground water conditions and a tabulation of ground water level data.

Prior Reports

Bulletin No. 39, entitled "Records of Ground Water Levels at Wells", was first published in 1932 as a part of the investigations initiated by Chapter 832, Statutes of 1929. Since then, water levels at selected wells have been published annually in Bulletins Nos. 39-A through 39-W, and Bulletins Nos. 39-56 through 39-59. Bulletin No. 39-56, the first of the numbered series, followed Bulletin No. 39-W without interruption in the continuity of data.

Since 1930, many bulletins covering various aspects of the hydrology of the South Coast Basin have been published by the Department of Water Resources and its predecessor, the Division of Water Resources. These bulletins include data on water use, ground water levels, quality of water, value and cost of water for irrigation, water losses and evaporation data, underground geology, and evaluation of overdraft on ground water basins in Southern California. Representative bulletins include:

California Department of Public Works, Division of Water Resources. "Santa Ana River Basin". Bulletin No. 31. 1930.

California Department of Public Works, Division of Water Resources. "South Coastal Basin, A Symposium". Bulletin No. 32. 1930.

California Department of Public Works, Division of Water Resources. "Rainfall Penetration and Consumptive Use of Water in Santa Ana River Valley and Coastal Plain". Bulletin No. 33. 1930.

California Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Quality of Irrigation Waters". Bulletin No. 40. 1933.

California Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Detailed Analyses Showing Quality of Irrigation Waters". Bulletin No. 40-A. 1933.

California Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Value and Cost of Water for Irrigation in Coastal Plain of Southern California". Bulletin No. 43. 1933.

California Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Water Losses Under Natural Conditions from Wet Areas in Southern California". Bulletin No. 44. 1933.

California Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Geology and Ground Water Storage Capacity of Valley Fill". Bulletin No. 45. 1934.

California Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Overdraft on Ground Water Basins". Bulletin No. 53. 1947.

California Department of Public Works, Division of Water Resources. "Report to the Assembly of the State Legislature on Water Supply of Antelope Valley in Los Angeles and Kern Counties". May 1947.

California Department of Public Works, Division of Water Resources. "Southern California Area Investigation, Memorandum Report on Water Conditions in Antelope Valley in Kern, Los Angeles and San Bernardino Counties". February 1955.

California Water Resources Board. "Los Angeles County Land and Water Use Survey, 1955". Bulletin No. 24, June 1956.

California Department of Water Resources. "Quality of Surface and Ground Waters in Upper Santa Ana Valley". Bulletin No. 40-57. June 1957.

California Department of Water Resources, Division of Resources Planning. "Sea-Water Intrusion in California". Bulletin No. 63. August 1958.

California Department of Water Resources. "Orange County Land and Water Use Survey, 1957". Bulletin No. 70. January 1959.

California Department of Water Resources. "Upper Santa Ana River Drainage Area Land and Water Use Survey, 1957". Bulletin No. 71. June 1960.

Summary

The protracted drought plaguing Southern California since the beginning of the 1944-45 season extended through another year as recorded precipitation in that area averaged approximately 70 percent of normal during the 1959-60 season. This series of subnormal years has been interrupted only by the wet seasons of 1951-52 and 1957-58.

Seasonal unimpaired runoff was considerably below normal and storage in most surface reservoirs was decidedly lower than that of a year ago, approaching an all-time low. In most areas ground water levels declined. In some of the more heavily pumped basins, overdraft conditions prevailed, and conditions favorable to the continued intrusion of sea water occurred in certain coastal basins where ground water levels fell below sea level.

The amount of supplemental water imported to coastal Southern California was increased 16 percent over that of the previous year; a total of 1,158,000 acre-feet being imported in an endeavor to compensate for the shortage of local supply, and to meet the ever-increasing demands. These waters were imported from the Owens River and Mono Basin by the City of Los Angeles, and from the Colorado River by The Metropolitan Water District of Southern California.

CHAPTER II. SURFACE WATER SUPPLY CONDITIONS

The 1959-60 season was another in a series of dry years in Southern California, extending the current dry period which began in 1944 to sixteen years. This protracted drought has been interrupted only by the wet years of 1951-52 and 1957-58. The manifestation of this subnormal season in terms of precipitation, runoff, storage in surface reservoirs, imports, runoff to the ocean and sewage discharges to the ocean, is discussed in the following pages.

Precipitation

Precipitation throughout Southern California during the 1959-60 season was generally below normal for all months except January. Normal, as used here, relates to the average for the 50 year period 1897-98 through 1946-47. The general distribution of precipitation, as indicated by lines of equal precipitation index, may be seen by an inspection of Plate 2, "Precipitation during 1959-60 in Percent of 50 Year Mean." As used in this bulletin, the precipitation index is the current year's precipitation at a station in percent of the 50 year mean. To provide a representative value of the precipitation over an area this index is averaged for a number of stations in the area; the result is designated as the average of precipitation indexes. For regions, a representative index is obtained by averaging the average of precipitation indexes for the areas in the region.

There was no appreciable precipitation in coastal Southern California until December, and by January 1, 1960, the seasonal total at Los Angeles reached only 26 percent of normal. The January precipitation raised the seasonal total at Los Angeles to 55 percent of normal, but dry conditions prevailed throughout the balance of the season for Los Angeles

and most of Southern California. The fluctuation of precipitation as the 1959-60 season advanced is shown on Table 1, which represents data on cumulative monthly precipitation for the 1959-60 season at selected stations. Data on Table 1 are related to precipitation for a 50 year mean (1897-1947), on Plate 3, "Representative Precipitation Characteristics in Southern California", where annual variations in precipitation are graphically portrayed for stations at San Luis Obispo, Los Angeles, San Diego, and Barstow.

Total seasonal precipitation in coastal Southern California was only about 70 percent of the 50 year mean. In the desert areas, the precipitation varied over a range from approximately 25 percent of the mean at Bishop to 110 percent at Blythe. The total seasonal precipitation in inches and percent of mean for selected stations, which represent a variety of areas in Southern California, is shown on Table 2.

Central Coastal Region (No. 3) - (Santa Barbara and San Luis Obispo Counties)

Precipitation data for hydrologic units in the Central Coastal Region are given in Table 3. Precipitation varied from a maximum of 88 percent of mean for the 50 year period 1897-1947 for stations in the Santa Maria Valley, to a minimum of 47 percent of the mean in the Cuyama River Valley. The average of precipitation indexes for all stations in this region was 68 percent of the mean. Measured precipitation at the City of San Luis Obispo for the season was 15.91 inches or 73 percent of the mean, while at Santa Barbara the precipitation was 10.82 inches, about 58 percent of the mean.

The Santa Barbara Weather Modification Project was continued in Santa Barbara and Ventura Counties for the fourth year as ground based silver iodide generators operated a total of 1400 hours in Santa Barbara County. This is a cooperative investigation to provide data for statistically testing

TABLE 1

CUMULATIVE MONTHLY PRECIPITATION
AT SAN LUIS OBISPO, LOS ANGELES,
SAN DIEGO AND BARSTOW

Month	Cumulative monthly precipitation at San Luis Obispo			Cumulative monthly precipitation at Los Angeles			Cumulative monthly precipitation at San Diego			Cumulative monthly precipitation at Barstow		
	50-year mean, 1897-1947, in inches	1959-60 Season In inches	1959-60 Season In percent of mean	50-year mean 1897-1947, in inches	1959-60 Season In inches	1959-60 Season In percent of mean	50-year mean 1897-1947, in inches	1959-60 Season In inches	1959-60 Season In percent of mean	50-year mean 1897-1947, in inches	1959-60 Season In inches	1959-60 Season In percent of mean
July	0.02	0	0	0.01	Trace	0	0.03	Trace	0	0.15	0.10	67
August	0.06	0	0	0.03	Trace	0	0.09	Trace	0	0.41	0.57	139
September	0.21	0.95	450	0.31	0.01	3	0.23	0.04	17	0.58	0.57	98
October	0.86	0.95	110	0.90	0.01	1	0.79	0.27	34	0.87	0.57	65
November	2.59	1.27	49	1.96	0.08	4	1.61	0.29	18	1.16	1.16	100
December	6.83	1.45	21	4.46	1.17	26	3.59	1.73	48	1.75	2.00	114
January	11.87	4.14	35	7.41	4.11	55	5.51	4.72	86	2.41	2.43	101
February	16.01	10.74	67	10.78	6.37	59	7.67	6.17	80	3.04	3.16	104
March	19.53	10.74	55	13.45	6.68	50	9.32	6.72	72	3.72	3.16	85
April	20.91	11.69	56	14.40	8.13	56	10.05	7.28	72	3.98	3.16	79
May	21.44	11.76	55	14.74	8.18	55	10.32	7.45	72	4.08	3.16	77
June	21.57	11.76	54	14.81	8.18	55	10.36	7.45	72	4.17	3.16	76

TABLE 2

SEASONAL AND MEAN PRECIPITATION AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA

Station	County	50-year mean, 1897-1947, in inches	1959-60 Season In inches	1959-60 Season In percent of mean
San Luis Obispo	San Luis Obispo	21.68	15.91	73
Paso Robles	San Luis Obispo	15.82	9.59	61
Santa Maria	Santa Barbara	13.52	10.78	80
Santa Barbara	Santa Barbara	18.56	10.82	58
Ventura	Ventura	15.59	11.04	71
Los Angeles	Los Angeles	14.81	8.18	55
Pomona	Los Angeles	18.21	10.28	56
Santa Ana	Orange	14.16	10.52	74
San Bernardino	San Bernardino	17.21	12.25	71
Bishop	Inyo	6.14	1.50	24
Barstow	San Bernardino	4.17	3.16	76
Blythe	Riverside	4.03	4.55	113
Brawley	Imperial	2.40	2.41	100
Oceanside	San Diego	12.38	8.77	71
San Diego	San Diego	10.36	7.45	72

the effectiveness of weather modification operations. Agencies participating in the project were: the University of California, Ventura County Flood Control District, The Santa Barbara County Water Agency, North America Weather Consultants, the United States Weather Bureau, the United States Forest Service, the Department of Water Resources. Many other agencies and individuals, who operated rain gages and supplied records, contributed to the project.

The history and a preliminary evaluation of this project are presented in "Interim Report of the Board of Directors, Santa Barbara Weather Modification Project", published by the Department of Water Resources in February 1960.

TABLE 3

AVERAGES OF PRECIPITATION INDEXES FOR STATIONS IN HYDROLOGIC UNITS IN CENTRAL COASTAL REGION NO. 3 FOR THE 1959-60 SEASON

Hydrologic Unit	Areal Designation: Code Number	Number of stations	Average precipitation index
Salinas Valley	3- 4.00	8	61
San Luis Obispo Group	3- 8.00	1	73
Arroyo Grande Group	3-11.00	1	86
Santa Maria River Valley	3-12.00	4	88
Cuyama River Valley	3-13.00	1	47
San Antonio Creek Valley	3-14.00	2	87
Santa Ynez River Valley	3-15.00	6	55
South Coast Basins, Santa Barbara County	3-16.00	3	59
Carrizo Plain	3-19.00	3	71
Cambria Group	3-21.00	1	84
Santa Barbara County Coastal Group	3-22.00	1	74
Southern Central Coastal Region		31	68

Los Angeles Region (No. 4)

Precipitation for the 1959-60 season averaged about 58 percent of normal for hydrologic units in the Los Angeles Region, as shown in Table 4. These data are based upon normals for the 50-year period 1897 to 1947. Precipitation measured at the United States Weather Bureau station at Los Angeles was 8.18 inches or 55 percent of the mean. It varied within the region from a high of 69 percent of the mean in the Ventura River Valley of Ventura County, to a low of 38 percent in Acton Valley in northern Los Angeles County.

Weather modification operations were conducted in both Ventura and Los Angeles Counties during the 1959-60 season. As part of the Santa Barbara

TABLE 4

AVERAGES OF PRECIPITATION INDEXES FOR STATIONS IN HYDROLOGIC UNITS IN LOS ANGELES REGION NO. 4 FOR THE 1959-60 SEASON

Hydrologic Unit	Areal Designation Code Number	Number of stations	Average precipitation index
Upper Ojai Valley	4- 1.00	2	59
Ojai Valley	4- 2.00	2	63
Ventura River Valley	4- 3.00	8	69
Santa Clara River Valley	4- 4.00	24	64
Acton Valley	4- 5.00	4	38
Pleasant Valley	4- 6.00	1	62
Arroyo Santa Rosa Valley	4- 7.00	1	58
Las Posas Valley	4- 8.00	6	60
Simi Valley	4- 9.00	2	64
Coastal Plain, Los Angeles County	4-11.00	64	66
San Fernando Valley	4-12.00	37	52
San Gabriel Valley	4-13.00	71	52
Upper Santa Ana Valley, Los Angeles County	4-14.00	7	55
Malibu Coastal Group	4-16.00	4	60
Los Angeles Region		233	58

Weather Modification Project previously discussed, ground based silver iodide generators were operated a total of 1,026 hours in Ventura County. The Los Angeles County Flood Control District logged 231 hours using ground based silver iodide generators in their Weather Modification Project above San Gabriel Dam in the San Gabriel Mountains. The results of this operation are outlined in a report entitled "Office Report on Cloud Seeding", prepared by the Los Angeles County Flood Control District.

Lahontan Region (No. 6) - (Southern Portion)

In the Lahontan Region the average of precipitation indexes for the 1959-60 season was 61 percent of the 50-year mean 1897-1947. From the data presented in Table 5, it will be noted that the indexes varied from a

TABLE 5

AVERAGES OF PRECIPITATION INDEXES FOR STATIONS IN HYDROLOGIC UNITS IN LAHONTAN REGION NO. 6 FOR THE 1959-60 SEASON

Hydrologic Unit	Areal Designation: Code Number	Number of stations	Average precipitation index
Mono Valley	6- 9.00	2	50
Long Valley	6-11.00	1	45
Owens Valley	6-12.00	8	47
Deep Springs Valley	6-15.00	1	46
Death Valley	6-18.00	1	88
Riggs Valley	6-23.00	1	72
Ivanpah Valley	6-30.00	1	129
Lower Mojave River Valley	6-40.00	1	76
Middle Mojave River Valley	6-41.00	2	73
Upper Mojave River Valley	6-42.00	3	59
Antelope Valley	6-44.00	18	64
Searles Valley	6-52.00	1	80
Rose Valley	6-56.00	2	65
Southern Lahontan Region		42	61

minimum of 45 percent of the mean at Long Valley just south of Mono Lake to a high of 129 percent at Mountain Pass just west of Ivanpah Valley. However, the data presented in Table 5 may not be truly indicative of area-wide conditions because of the paucity of observation stations in the Region.

Weather modification activities within the Lahontan Region of the Southern California District were limited to the Mammoth Lake area. Here the Weather Modification Company seeded with silver iodide using air-borne methods for a total of three hours. Reports evaluating this seeding operation were not available to the Department of Water Resources as of the date of this report.

Colorado River Basin Region (No. 7)

Precipitation in the Colorado River Basin Region varied over a wide range from the normal as indicated by data presented in Table 6. However, there are no available data for over two thirds of the hydrologic units in this area; therefore, the data presented may not be truly indicative of the conditions which prevailed in the region. The average of precipitation indexes for those hydrologic units for which data are available varied from a high of 185 percent of the 50-year mean (1897-1947) in Ward Valley in the northeastern portion of the region, to a low of 45 percent in Coyote Wells Valley in the southwest portion with the average of precipitation indexes for the entire region being approximately 94 percent.

There were no reports of weather modification activities in this region during the 1959-60 season.

Santa Ana Region (No. 8)

The average of precipitation indexes in the Santa Ana Region, as shown in Table 7, for the 1959-60 season was 67 percent of the 50-year mean. The average of precipitation indexes varied from a low of 63 percent of the mean in the Upper Santa Ana Valley to a maximum of 80 percent in Bear Valley. Measured precipitation at the United States Weather Bureau Station in the City of Santa Ana was 10.52 inches, or about 74 percent of the mean.

During the 1959-60 season weather modification operations were conducted in the Santa Ana River Drainage Basin by the Santa Ana River Weather Corporation. Ground based silver iodide generators were used for a total of 2,406 hours between December 8, 1959, and May 5, 1960. Reports evaluating this weather modification operation were not available to the Department of Water Resources as of the date of this report.

TABLE 6

AVERAGES OF PRECIPITATION INDEXES FOR STATIONS IN HYDROLOGIC UNITS IN COLORADO RIVER BASIN REGION NO. 7 FOR THE 1959-60 SEASON

Hydrologic Unit	Areal Designation: Code Number	Number of stations	Average precipitation index
Ward Valley	7- 3.00	1	185
Chuckawalla Valley	7- 5.00	1	149
Twentynine Palms Valley	7-10.00	1	74
Means Valley	7-17.00	1	84
Lucerne Valley	7-19.00	1	57
Morongo Valley	7-20.00	1	76
Coachella Valley	7-21.00	11	79
Borrego Valley	7-24.00	1	92
Terwilliger Valley	7-26.00	1	83
San Felipe Valley	7-27.00	1	144
Coyote Wells Valley	7-29.00	1	45
Imperial Valley	7-30.00	4	72
Orcopia Valley	7-31.00	1	137
East Salton Sea Valley	7-33.00	1	150
Palo Verde Valley	7-38.00	3	103
Calzona Valley	7-41.00	1	127
Needles Valley	7-44.00	1	145
Colorado River Basin Region		32	94

TABLE 7

AVERAGES OF PRECIPITATION INDEXES FOR STATIONS IN HYDROLOGIC UNITS IN SANTA ANA REGION NO. 8 FOR THE 1959-60 SEASON

Hydrologic Unit	Areal Designation Code Number	Number of stations	Average precipitation index
Coastal Plain, Orange County	8-1.00	42	70
Upper Santa Ana Valley	8-2.00	43	63
Elsinore Valley	8-4.00	1	68
San Jacinto Valley	8-5.00	2	79
Bear Valley	8-9.00	1	80
Santa Ana Region		89	67

San Diego Basin Region (No. 9)

Precipitation in the San Diego Region for the 1959-60 season averaged 76 percent of the 50-year mean. From data presented in Table 8, it will be noted that precipitation in the region varied from a high of 93 percent of the mean in the Coahuila Valley to a low of 65 percent in Mission Valley. Precipitation at the City of San Diego measured 7.45 inches or 72 percent of the mean.

Runoff

Runoff throughout Southern California was below normal during the 1959-60 water year, reflecting the subnormal seasonal precipitation. The estimated unimpaired seasonal runoff (runoff unaffected by the works of man) for the Arroyo Seco near Pasadena was 11 percent of normal, based on the mean for the 53-year period 1894-95 through 1946-47. Similar values for the Santa Ana River near Mentone, Sespe Creek near Fillmore and Huasna River near Santa Maria were 28 percent, 14 percent and 7 percent of the mean, respectively.

TABLE 8

AVERAGES OF PRECIPITATION INDEXES FOR STATIONS IN HYDROLOGIC UNITS IN SAN DIEGO REGION NO. 9 FOR THE 1959-60 SEASON

Hydrologic Unit	Areal Designation: Code Number	Number of stations	Average precipitation index
San Juan Valley	9- 1.00	5	82
Coahuila Valley	9- 6.00	1	93
San Luis Rey Valley	9- 7.00	2	80
Warner Valley	9- 8.00	3	80
San Pasqual Valley	9-10.00	1	82
Santa Maria Valley	9-11.00	2	76
Poway Valley	9-13.00	1	74
Mission Valley	9-14.00	5	65
San Diego River Valley	9-15.00	3	74
Sweetwater Valley	9-17.00	5	71
Otay Valley	9-18.00	2	72
Tia Juana Valley	9-19.00	1	82
Santa Ysabel Valley	9-45.00	1	86
San Diego Region		32	76

The estimated unimpaired seasonal runoff of the Owens River below Long Valley was about 60 percent of the 53-year mean. The deficiency in supply in this and the previous year necessitated the activation of wells in the Owens Valley to supplement surface water deliveries to Los Angeles for the first time since 1932. The measured flow of the Colorado River at Lee's Ferry, Arizona, uncorrected for upstream storage or diversion, was approximately 9,185,000 acre-feet, or 77 percent of the average for the 34-year period 1922-23 through 1955-56.

Table 9 presents data on the estimated or measured seasonal unimpaired runoff during the 1959-60 water year at selected stations representative of conditions in Southern California. This table also shows a comparison of the 53-year mean unimpaired runoff with the estimated or measured

TABLE 9

ESTIMATED 1959-60 SEASONAL UNIMPAIRED RUNOFF AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA

In acre-feet

Station	Period of record	1959-60	53-year mean[a]	Maximum[b]		Minimum[b]	
				Season	Quantity	Season	Quantity
Central Coastal Region							
Arroyo Grande at Arroyo Grande	1939 to date	4,310[c]	23,900	1906-07	76,200	1930-31	800
Huasna River near Santa Maria	1929 to date	1,400	20,600	1906-07	74,400	d	0
Los Angeles Region							
Sespe Creek near Fillmore	1911-13 1927 to date	12,890	93,900	1940-41	376,000	1950-51	3,520
Arroyo Seco near Pasadena	1910 to date	780	7,300	1921-22	25,400	1898-99	160
Santa Anita Creek near Sierra Madre	1916 to date	990	4,920	1942-43	16,600	1898-99	210
San Gabriel River near Azusa	1894 to date	19,950	122,000	1921-22	410,000	1898-99	9,620
Lahontan Region							
Owens River below Long Valley	1916 to date	101,620	168,500	1906-07	292,000	1930-31	73,010
Rock Creek near Valyermo	1923-37 1938 to date	2,130	15,000	1921-22	39,000	1950-51	1,380
Deep Creek near Hesperia	1904-22 1929 to date	8,700	47,100[e]	1921-22	177,000[f]	1950-51	4,340[f]
Colorado River Basin Region							
Colorado River at Lees Ferry	1911 to date	9,185,000[c]	12,009,000[cg]	1916-17	21,860,000[cf]	1933-34	4,377,000[cf]
Colorado River at Hoover Dam	1933 to date	9,250,000[c]	11,168,000[ch]	1941-42	17,880,000[cf]	1933-34	5,058,000[cf]

ESTIMATED 1959-60 SEASONAL UNIMPAIRED RUNOFF AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA
(continued)

In acre-feet

Station	Period of record	1959-60	53-year mean[a]	Maximum[b]		Minimum[b]	
				Season	Quantity	Season	Quantity
Colorado River Basin Region (continued)							
Colorado River at Yuma	1878 to date	1,727,000[ci]	5,646,000[chi]	1908-09	26,070,000[cf]	1955-56	894,000[cf]
Palm Canyon Creek near Palm Springs	1930-41 1947 to date	120	3,580[j]	1936-37	18,980[f]	1955-56	0.2[f]
Santa Ana Region							
Cucamonga Creek near Upland	1928 to date	1,600	6,190	1921-22	20,900	1898-99	930
Santa Ana River near Mentone	1896 to date	19,980	70,600	1915-16	280,000	1950-51	13,090
San Diego Region							
Murrieta Creek at Temecula	1930 to date	460	8,670	1915-16	60,300	1933-34	420
Santa Ysabel Creek at Sutherland Dam	1936 to date	1,040	15,200	1915-16	95,200	1954-55	700
Cottonwood Creek at Morena Dam	1911 to date	320	12,400	1915-16	75,300	1955-56	130

a. Mean for period 1894-95 through 1946-47, except as noted.
b. Indicated maxima and minima are recorded or estimated values for period 1894-95 to date, except as noted.
c. Measured runoff, unadjusted for upstream development.
d. Zero flow reported for eleven seasons.
e. Average for period 1920-21 through 1949-50.
f. Indicated maxima and minima are recorded or estimated values for given period of record.
g. Average for period 1922-23 through 1955-56.
h. Average for period 1936-37 through 1955-56.
i. Includes discharges from Yuma Main Canal Wasteway and California Drainage Canal.
j. Average for period 1930-31 through 1940-41, and 1947-48 through 1957-58.

minimum and maximum for each station during the period of record. Data on the historical unimpaired seasonal runoff and the accumulated deviation from the mean unimpaired seasonal runoff, for the period 1894 to the present are delineated on Plate 4, "Representative Runoff Characteristics in Southern California", for four selected streams.

Discharge to the Ocean

The subnormal water supply for the 1959-60 season and the conservation activities of local agencies resulted in the discharge of only 103,520 acre feet to the ocean from major streams in Southern California during the 1959-60 season. This is a reduction of about 25,000 acre feet from the 1958-59 seasonal total of 128,213 acre feet. For the most part, the discharge to the ocean represented runoff from urban areas near the coast where conservation is not economically feasible plus industrial waste which is discharged to water courses in the coastal area.

Data on discharge to the ocean during the 1959-60 season, from 17 streams which drain the major portion of coastal Southern California, are presented in Table 10. For comparative purposes, the discharge from these streams for the preceding year is also shown.

Storage in Surface Reservoirs

As the prolonged drought continued through the 1959-60 season, there was a general decrease in the volume of water stored in reservoirs in Southern California. All reservoirs in which there was an increase in the amount of water stored were used in the regulation of imported water. Data on storage in selected surface reservoirs located in Southern California, or supplying water to that area, are presented in Table 11. Data are shown for October 1, 1959, and October 1, 1960.

TABLE 10

ESTIMATED SEASONAL DISCHARGE TO THE OCEAN
FROM SELECTED STREAMS IN SOUTHERN CALIFORNIA
DURING 1958-59 AND 1959-60

Stream	Discharge, in acre-feet 1958-59	Discharge, in acre-feet 1959-60
Central Coastal Region		
Santa Maria River	0	0
Santa Ynez River	11,960	170
Los Angeles Region		
Ventura River	5,960	1,370
Santa Clara River	19,310	330
Ballona Creek	17,170	22,250
Dominguez Channel	13,270	15,790
Los Angeles River	49,390	49,110
Los Cerritos Channel	2,410	3,780
San Gabriel River	5,750*	6,280*
Santa Ana Region		
Santa Ana River	340	650
Santa Ana Delhi Drain	790	1,310
Peters Canyon Drain	240	820
San Diego Region		
Aliso Creek	3	10
Trabuco Creek	30	100
San Juan Creek	1,590	1,550
Santa Margarita River	0	0
San Luis Rey River	0	0
TOTALS	128,213	103,520

* Includes discharge from Coyote Creek.

In Coastal Southern California, 239,360 acre-feet of local water was stored in those reservoirs having an individual storage capacity of 10,000 acre-feet or more, as of October 1, 1960. This amounted to about 18 percent of total storage capacity, and was slightly less than the volume of water stored on October 1, 1959, when these reservoirs were filled to about 23 percent of their capacity. Reservoirs storing only imported water, or a mixture of imported and local waters, contained 316,100 acre-feet, or 48 percent of capacity on October 1, 1960, as compared with 53 percent of capacity on October 1, 1959.

Water in storage in San Diego County decreased from 99,920 acre-feet on October 1, 1959, to 90,030 acre-feet, or 13 percent of capacity, on October 1, 1960. This decrease in amount of water stored occurred despite the importation of 165,260 acre-feet of Colorado River water during the year.

Total storage of water in the three major reservoirs of the Los Angeles Department of Water and Power in the Owens Valley decreased from 60 percent of capacity on October 1, 1959, to 49 percent of capacity on October 1, 1960. These reservoirs are primarily used for the regulation of flow through the Los Angeles Aqueduct.

Water storage in Lake Mead on the Colorado River was 19,940,000 acre-feet on October 1, 1960. This indicated a decrease in the amount stored of less than one-half of one percent during the 1959-60 water year.

The water surface elevation of the Salton Sea as of October 1, 1960, was 234.0 feet below sea level, reflecting an increase of 0.8 foot in elevation since October 1, 1959. The Salton Sea is the collection point of an internal drainage basin covering 7,500 square miles. Contributions to the sea, which covers 349 square miles, include runoff from the entire basin and

TABLE 11

WATER IN STORAGE IN SELECTED SURFACE RESERVOIRS
IN, OR SUPPLYING WATER TO, SOUTHERN CALIFORNIA
ON OCTOBER 1, 1959 AND OCTOBER 1, 1960

Watershed	Reservoir	Capacity, in acre-feet	Water in storage, in acre-feet		Water in storage, in percent of capacity	
			October 1, 1959	October 1, 1960	October 1, 1959	October 1, 1960
Central Coastal Region						
Cuyama	Twitchell	239,000	0	0	0	0
Santa Ynez River	Gibraltar	15,600	9,500	4,360	61	28
	Cachuma	206,500	187,090	163,070	91	79
Los Angeles Region						
Coyote Creek	Casitas	250,000	6,450	5,610	3	2
Piru Creek	Lake Piru	100,000	6,390	1,560	6	2
Bouquet Creek	Bouquet Canyon[a]	36,500	33,420	33,970	92	93
San Gabriel River	Morris	35,170	22,120	22,410	63	64
Lahontan Region						
Rush Creek	Grant Lake[a]	47,530	17,240	10,630	36	22
Owens River	Long Valley[a] (Lake Crowley)	183,470	115,760	89,140	63	49
Rose Valley	Haiwee[a]	58,530	41,920	42,990	72	73
Colorado River Basin Region						
Colorado River	Lake Mead	27,207,000	20,036,000	19,940,000	74	73
	Lake Mohave	1,810,000	1,385,700	1,465,000	77	81
	Lake Havasu	688,000	555,400	557,000	81	81

WATER IN STORAGE IN SELECTED SURFACE RESERVOIRS
IN, OR SUPPLYING WATER TO, SOUTHERN CALIFORNIA
ON OCTOBER 1, 1959 AND OCTOBER 1, 1960
(continued)

Watershed	Reservoir	Capacity, in acre-feet	Water in storage, in acre-feet		Water in storage, in percent of capacity	
			October 1, 1959	October 1, 1960	October 1, 1959	October 1, 1960
Santa Ana Region						
Bear Creek	Bear Valley	72,170	13,150	6,780	18	9
San Jacinto River	Lake Hemet	13,400	5,120	3,350	38	25
	Railroad Canyon	14,700	1,170[b]	850[b]	8	6
Cajalco Creek	Lake Mathews	100,000	56,980[b]	61,780[b]	57	62
Santiago Creek	Santiago	25,000	10,210[b]	3,820[b]	41	15
San Diego Region						
Temecula Creek	Vail	49,500	3,110	1,090	6	2
San Luis Rey River	Lake Henshaw	194,320	3,750	930	2	0.5
Santa Ysabel Creek	Sutherland	29,680	6,270	3,080	21	11
San Dieguito River	Lake Hodges	33,550	2,500[c]	3,710[c]	7	11
San Vicente Creek	San Vicente Lake	90,230	48,950[c]	51,030[c]	54	56
Boulder Creek	Cuyamaca	11,600	0	0	0	0
San Diego River	El Capitan Lake	112,810	22,830	14,470	20	13
Sweetwater River	Lake Loveland	25,390	790	1,070	3	4
	Sweetwater (Main)	27,690	5,010	3,380	18	12
Cottonwood Creek	Morena Lake	50,210	880	810	2	2
Otay River	Barrett Lake	44,760	1,130	1,210	2	3
	Lower Otay Lake	56,520	5,580	4,060	10	7

a. Component of the Aqueduct System of the City of Los Angeles.
b. Includes Colorado River water imported via Colorado River Aqueduct.
c. Includes Colorado River water imported via Colorado River and San Diego Aqueducts.

poor quality irrigation drainage waters from irrigated lands in the Coachella, Imperial, and Mexicali Valleys.

Colorado River Diversions

The total diversion of water from the Colorado River by principal water agencies in California amounted to approximately 4,787,000 acre-feet during the 1959-60 water year. This represents an increase of four percent over the previous year. The volume of water diverted by each of the principal diversion agencies in California during the 1958-59 and 1959-60 water years is presented in Table 12.

TABLE 12

QUANTITIES AND PERCENT CHANGE IN AMOUNT OF WATER DIVERTED FROM THE COLORADO RIVER FOR USE IN CALIFORNIA DURING 1958-59 AND 1959-60

Agency	Diversion, in acre-feet		Percent
	1958-59	1959-60	change
The Metropolitan Water District of Southern California	655,950	839,760	+ 28.0
Palo Verde Irrigation District	448,210	377,190	- 15.9
Imperial Irrigation District	2,940,210	3,024,080	+ 2.9
Coachella Valley County Water District	508,000	502,500	- 1.1
Yuma Project (Reservation Division)	35,790	43,100	+ 20.4
TOTALS	4,588,160	4,786,630	+ 4.3

Importation to Coastal Southern California

The Metropolitan Water District of Southern California and the City of Los Angeles, Department of Water and Power imported a total of 1,158,000 acre-feet of water to coastal Southern California during the 1959-60 season. This represents an increase of 167,000 acre-feet over the volume imported during the 1958-59 water year. Data on historical amounts of water imported to Coastal Southern California are presented graphically on Plate 5, "Historical Importations of Water to Coastal Southern California".

Deliveries through the Colorado River Aqueduct, measured at the Hayfield Pumping Plant, the fourth plant located about 125 miles from the start of the aqueduct, totaled about 822,000 acre-feet. This was about 175,000 acre-feet greater than that imported during 1958-59, an increase of 27 percent. Deliveries of water to member agencies of The Metropolitan Water District of Southern California totaled about 801,000 acre-feet during the water year, an increase of about 31 percent over the 1958-59 season. Data on volumes of Colorado River water delivered to each of the coastal counties during 1958-59 and 1959-60 are presented in Table 13. The difference in data between the volume of imported water measured at the Hayfield Pumping Plant and the deliveries to the various counties shown in Table 13 is accounted for by an increase of about 5,000 acre-feet of water stored in Lake Mathews and by unavoidable aqueduct and distribution system losses.

Table 13 indicates substantial increases in the deliveries to San Diego and Orange Counties. The completion of the major portion of the second San Diego Aqueduct permitted the increased delivery of water to San Diego County, while increased spreading by the Orange County Municipal Water District accounts for essentially all of the added deliveries to Orange County.

TABLE 13

COLORADO RIVER WATER
IMPORTED TO COUNTIES IN COASTAL SOUTHERN CALIFORNIA
DURING 1958-59 AND 1959-60

County	Seasonal import, in acre-feet 1958-59	Seasonal import, in acre-feet 1959-60	Percent change
Los Angeles County	316,250	352,700	+ 11.5
San Diego County	110,650	165,260	+ 49.4
Orange County	138,450	236,130	+ 70.6
Riverside County	39,900	42,900	+ 7.5
San Bernardino County	4,050	3,620	- 10.6
TOTALS	609,300	800,610	+ 31.4

A total of 336,000 acre-feet of water, which is the estimated flow from Fairmont Reservoir, was imported into the Los Angeles area from the Owens River-Mono Basin area through the aqueduct of the City of Los Angeles, Department of Water and Power. As previously indicated this flow included extractions of ground water from the Owens Valley for the first time since 1932. The aqueduct was operated at capacity during the entire 1959-60 water year, with the exception of short periods of shutdown for routine maintenance and inspection.

Sewage Discharge to Saline Waters

During the 1959-60 fiscal year, approximately 720,000 acre-feet of sewage effluent were discharged into the Pacific Ocean and its tidal estuaries through the 11 outfalls which dispose of essentially all such waste along the coast of Southern California. Table 14 indicates the amount of effluent discharged through each outfall for 1959-60, and compares it with the disposal figure for 1958-59. The totals in this table indicate that the 1959-60 discharge was four percent greater than that observed during the 1958-59 year. This probably reflects the increased water use of the expanding population

TABLE 14

SEWAGE DISCHARGED TO OCEAN WATERS IN 1958-59 AND 1959-60
THROUGH MAJOR DISPOSAL FACILITIES IN SOUTHERN CALIFORNIA

Station	Discharge, in acre-feet 1958-59	Discharge, in acre-feet 1959-60	Percent charge
City of Santa Barbara	5,240	5,570	+ 6.3
City of Ventura	4,000	2,680	- 33.0
City of Oxnard	3,320	3,740	+ 12.7
City of Los Angeles			
Hyperion	293,790	290,680	- 1.1
Terminal Island	6,950	7,160	+ 3.0
County Sanitation Districts of Los Angeles County	263,650	289,170	+ 9.7
County Sanitation Districts of Orange County	53,850	60,260	+ 11.9
City of Oceanside	2,050	0[a]	-100.0
City of San Diego	51,500	53,680	+ 4.2
Coronado Island	2,020	2,020	0
City of Chula Vista	2,800	3,090	+ 10.4
International Outfall Sewer	4,980	4,920	- 1.2
TOTALS	694,150	722,970	+ 4.1

a. City of Oceanside reclaimed 2,375 acre-feet of sewage effluent for agricultural use and ground water replenishment in Mission Basin.

concurrent with an increased per capita use of water and the extension of sewers into urban areas formerly served by cesspools and septic tanks.

The only two major decreases in discharge were shown by the Cities of Ventura and Oceanside. The decrease shown by the City of Ventura was a return to normal after an inflated discharge figure for 1958-59, as the result of the infiltration into the sewer lines of flow in the Ventura River. The zero discharge figure for the City of Oceanside is the result of reclamation of the sewage effluent. A portion of the reclaimed water was used for direct irrigation while the remainder was percolated for replenishment of ground water in the mission San Luis Rey Basin.

CHAPTER III. GROUND WATER SUPPLY CONDITIONS

As stated in Chapter II, the 1959-60 water crop was far below normal throughout Southern California. A comparison of ground water level measurements taken in the spring of 1959 and the spring of 1960 shows a drop in water surface elevation in most ground water basins. However, artificial recharge activities have arrested these declines in a number of basins. This chapter presents a brief summary of ground water supply conditions in many of the ground water basins in the Southern District during the 1959-60 season. Artificial recharge activities are also summarized.

Ground Water Conditions

When precipitation and surface runoff are subnormal ground water levels generally decline, thus the 1959-60 season in Southern California saw a continuation of the trend of general decline in ground water levels, and conditions favorable to sea-water intrusion were intensified in some of the coastal basins.

Discussions of ground water conditions based on spring 1959 to spring 1960 data for the various regions and basins in the Southern California area are presented in the following sections. Water Pollution Control Board regions, ground water basins, and well locations are shown on Plates 6 through 11, and the fluctuation of ground water elevations of selected wells are shown by the hydrographs presented on Plates 12A and 12B.

Central Coastal Region (No. 3) (Santa Barbara and San Luis Obispo Counties)

Ground water levels generally decreased in elevation in ground water basins in the San Luis Obispo and Santa Barbara Counties segment of the Central Coastal Region between the spring of 1959 and the spring of

1960. Observed ground water elevations were generally above sea level in all areas within the region, except for the south coast basins of Santa Barbara County.

Available ground water level records for the Central Coastal Region, for the period July 1959 through June 1960, are tabulated in Volume II, Appendix A. The estimated average changes in ground water level elevations for selected basins in this region are given in Table 15. The locations of selected wells at which ground water level fluctuations have been obtained for hydrograph presented on Plate 12A are shown on Plate 6, "Location of Wells at which Water Level Fluctuations are Shown - Central Coastal Region (No. 3)".

In the Upper Salinas Valley, ground water levels in the Paso Robles Basin declined an average of two and one-half feet. Depths to ground water ranged from flowing at a well one mile southwest of Linne, to 291 feet below the ground surface two miles east of Paso Robles.

In the Arroyo Grande Basin ground water level observations indicated that generally the ground water declined an average of three feet. Depth to ground water ranged from seven feet below ground surface three miles south of Oceano, to 89 feet below ground surface one mile north of Oceano.

Ground water levels declined an average of about six and one-half feet in the Santa Maria Valley. Observed depths to ground water varied from 14 feet below ground surface one-half mile west of Bromela, to 293 feet below ground surface two miles southeast of Nipomo.

Ground water levels declined in all basins in the Santa Ynez River Valley, varying from an average decline of about one-half foot in the Headwater Subarea, to a decline of about three feet in the Lompoc Subarea.

TABLE 15

AVERAGE CHANGE IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO.3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1959-60

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
3-4.00	Salinas Valley				
3-4.06	Paso Robles Basin	38	- 2-1/2	26S/12E-26D1, M 291.1	27S/13E-21N1, M Flowing
3-8.00	San Luis Obispo Group				
3-8.01	Morro Basin	4	-12-1/2	29S/11E-19P1, M 57.6	29S/10E-25D1, M 14.0
3-8.02	Chorro Basin	1	+ 2	29S/11E-32J2, M 34.0	29S/11E-32J2, M 13.0
3-8.03	Los Osos Basin	3	- 2	30S/11E-7K1, M 42.4	30S/10E-13G1, M 17.1
3-8.04	San Luis Obispo Basin	5	0	31S/12E-28N1, M 36.3	31S/12E-4K1, M 11.0
3-8.05	Pismo Basin	2	+ 1/2	31S/13E-16N1, M 56.9	32S/12E-13R1, M 4.5
3-11.00	Arroyo Grande Group				
3-11.01	Arroyo Grande Basin	5	- 3	32S/13E-29N1, M 88.6	12N/35W-30P1, S 7.2

AVERAGE CHANGE IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO. 3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1959-60
(continued)

	Hydrologic unit or basin	Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
3-11.02	Nipomo Mesa Basin	3	+ 1/2	11N/35W-11B1, S 308.4	11N/35W- 7R1, S 58.8
3-12.00	Santa Maria River Valley	23	- 6 1/2	11N/34W-19Q1, S 293.1	11N/35W-20E1, S 13.6
3-13.00	Cuyama River Valley	11	- 5 1/2	9N/26W-4J1, S 294.6	7N/24W-13C2, S 24.1
3-14.00	San Antonio Creek Valley	4	+ 1	8N/32W-35Q1, S 152.5	8N/34W-16G1, S Flowing
3-15.00	Santa Ynez River Valley				
3-15.01	Lompoc Subarea	46	- 2 1/2	7N/34W-12E1, S 306.0	7N/35W-35C4, S 3.2
3-15.02	Santa Rita Subarea	22	- 1/2	6N/33W-7A1, S 55.0	6N/32W-17D3, S 3.8
3-15.03	Buellton Subarea	18	- 1	6N/32W-2Q1, S 60.2	6N/32W-12R2, S 3.0
3-15.04	Santa Ynez Subarea	22	- 1	7N/30W-33M2, S 183.9	6N/30W-29D3, S 6.2
3-15.05	Headwater Subarea	3	- 1/2	6N/30W-24H1, S 17.3	6N/30W-24E1, S 2.6

AVERAGE CHANGE IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO. 3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
3-16.00	South Coast Basins (Santa Barbara Co.)				
3-16.01	Goleta Basin	19	- 2 1/2	4N/27W-6Q9, S 248.9	4N/28W-17R1, S 0.8
3-16.02	Santa Barbara	3	- 1	4N/27W-7J2, S 100.2	4N/27W-18R2, S 35.1
3-16.04	Carpinteria Basin	18	- 4	4N/25W-26C2, S 296.3	4N/25W-30D1, S 5.4
3-19.00	Carrizo Plain	3	+ 1 1/2	29S/17E-13R1, M 35.1	30S/18E-2N1, M 17.2
3-21.00	Cambria Group				
3-21.03	San Simeon Basin	1	- 1	27S/08E-9L1, M 12.7	27S/08E-9L1, M 9.1
3-21.04	Santa Rosa Basin	2	0	27S/08E-24J1, M 27.5	27S/08E-26C1, M 7.0
3-21.05	Villa Basin	1	- 1/2	28S/09E-23E2, M 20.0	28S/09E-23E2, M 19.5

AVERAGE CHANGE IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO. 3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
3-21.07	Old Basin	1	-14 1/2	28S/10E-34N3,M 37.0	28S/10E-34N3,M 18.5
3-21.08	Toro Basin	1	+ 1/2	29S/10E-1P1,M 9.7	29S/10E- 1P1,M 7.1

In the South Coast Basins of Santa Barbara County observed ground water levels showed slight declines. Static water levels at many of the wells in the Goleta and Carpinteria Basins were below sea level during the entire season, and conditions favorable to sea-water intrusion continued. Minimum observed ground water level elevations were 41 feet below sea level in the Goleta Basin and 33 feet below sea level in the Carpinteria Basin.

Los Angeles Region (No. 4)

Ground water levels in this region generally declined between the spring of 1959 and the spring of 1960 with an extreme average decline of 44 feet being observed in the Ojai Valley in Ventura County. There were numerous basins having average declines of more than 10 feet, however, several basins showed slight increases in ground water elevations, due primarily to artificial recharge activities. Ground water levels in most of the coastal ground water basins remained below sea level during the entire year, and conditions favorable to sea-water intrusion prevailed.

The estimated average change in ground water elevations for selected ground water basins in the Los Angeles Region is presented in Table 16, and a complete tabulation of ground water levels for this region for the period July 1959 through June 1960 is presented in Volume II, Appendix B. Historical fluctuations of ground water levels at selected wells, whose location is shown on Plate 7, "Location of Wells at Which Water Level Fluctuations are Shown -- Los Angeles Region (No. 4)", are graphically indicated on Plate 12A.

In Ventura County, ground water level observations indicate a substantial decline in ground water elevations. Declines were especially noticeable in Ojai Valley, Oxnard Plain Forebay Area, Oxnard Plain Pressure

TABLE 16

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4) DURING 1959-60

	Hydrologic unit or basin	Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
4-1.00	Upper Ojai Valley	3	- 7	4N/22W-12F1, S 148.8	4N/22W-10K2, S 18.2
4-2.00	Ojai Valley	61	-44	4N/22W- 5J6, S 254.1	4N/23W-12B1, S Flowing
4-3.00	Ventura River Valley				
4-3.02	Upper Ventura River Basin	78	- 2-1/2	4N/23W-21C5, S 164.6	4N/23W-21F2, S 3.5
4-4.00	Santa Clara River Valley				
4-4.01	Oxnard Plain Pressure Area	84	-13	1N/21W- 4P1, S 132.9	1N/22W-17D2, S 6.3
4-4.02	Oxnard Plain Forebay Area	21	-31-1/2	2N/22W-12K2, S 104.3	2N/22W-11B1, S 44.2
4-4.03	Mound Pressure Area	28	- 7-1/2	2N/22W- 9K3, S 256.1	2N/23W-11N1, S 7.0
4-4.04	Santa Paula Basin	46	- 1-1/2	2N/22W- 3M2, S 232.8	2N/22W- 2K4, S 3.5
4-4.05	Fillmore Basin	58	- 8	4N/20W-31H1, S 300.8	3N/20W- 8F2, S 3.1
4-4.06	Piru Basin	24	-22-1/2	4N/14W-20M1, S 193.6	4N/19W-33K5, S 15.5
4-4.07	Eastern Basin	15	- 7-1/2	5N/14W-30R1, S 220.0	4N/17W-15N1, S Flowing

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4) DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
4-6.00	Pleasant Valley	48	- 9-1/2	2N/21W-24F1, S 367.9	2N/21W-35C1, S 31.3
4-7.00	Arroyo Santa Rosa Valley	23	- 8-1/2	2N/19W-21H1, S 269.0	2N/19W-19L1, S 49.1
4-8.00	Las Posas Valley				
4-8.01	West Las Posas Basin	8	-10	2N/21W-12G1, S 353.5	2N/21W-16J1, S 93.4
4-8.02	East Las Posas Basin	52	- 2-1/2	3N/20W-33M2, S 542.0	2N/19W- 3A4, S 33.8
4-9.00	Simi Valley	70	- 1-1/2	2N/18W- 1F1, S 321.0	2N/18W- 7R2, S 6.2
4-10.00	Conejo Valley	90	- 5-1/2	1N/19W- 9H2, S 240.7	1N/19W-15E2, S 2.5
4-11.00	Coastal Plain (Los Angeles County)				
4-11.01	Santa Monica Basin	40	- 2	1S/15W-25C1, S 198.0	2S/15W-27L2, S 3.5
4-11.02	West Coast Basin	211	- 1/2	2N/19W-33H1, S 274.8	5S/13W- 3Q2, S 1.7

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
4-11.03	Central Basin Pressure Area	263	- 1-1/2	3S/13W-34G1, S 270.0	5S/12W-11D1, S 4.5
4-11.04	Los Angeles Forebay Area	46	- 1-1/2	2S/13W- 2M1, S 442.0	1S/13W-35F1, S 4.8
4-11.05	Montebello Forebay Area	136	- 8-1/2	1S/12W-33P2, S 333.0	2S/11W- 6M1, S 4.0
4-11.06	Hollywood Basin Area	1	- 1/2	1S/14W-18J1, S 145.1	1S/14W-19D6, S 19.6
4-11.08	Whittier Area	8	- 2-1/2	3S/11W-12P1, S 282.0	3S/11W- 1P2, S 28.9
4-12.00	San Fernando Valley				
4-12.01	San Fernando Basin	130	- 6-1/2	1N/14W-13R1, S 342.0	2N/16W-34G1, S Flowing
4-12.02	Bull Canyon Basin	1	+ 1/2	2N/16W- 2G1, S 126.1	2N/16W- 2G1, S 125.8
4-12.03	Sylmar Basin	14	- 2	3N/15W-26G1, S 234.6	3N/15W-34P7, S 25.5
4-12.05	Tujunga Basin	20	+11-1/2	2N/13W-18N1, S 384.0	2N/14W-14B1, S 7.7
4-12.07	Verdugo Basin	16	+ 1	2N/13W-27N1, S 170.7	1N/13W-10Q1, S 20.9

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
4-13.00	San Gabriel Valley				
4-13.01	Main San Gabriel Basin	181	- 7-1/2	1S/12W- 3M1, S 385.0	1S/12W-24B3, S 0.1
4-13.02	Monk Hill Basin	18	-15	1N/12W- 6D2, S 309.2	1N/12W-17D1, S 117.6
4-13.03	Pasadena Subarea	54	- 5	1N/12W-23G1, S 342.4	1N/11W-29K1, S Flowing
4-13.04	Santa Anita Subarea	12	-16-1/2	1N/11W-21C2, S 242.7	1N/11W-15L2, S 11.8
4-13.05	Upper Canyon Basin	11	-11-1/2	1N/10W-27J1, S 156.9	1N/10W-23A2, S 23.4
4-13.06	Lower Canyon Basin	5	-16-1/2	1N/10W-29J1, S 143.0	1N/10W-35B1, S 15.0
4-13.07	Glendora Basin	8	- 4-1/2	1N/ 9W-29C1, S 427.0	2S/10W-15F4, S 13.0
4-13.08	Way Hill Basin	10	- 4-1/2	1S/ 9W- 8C2, S 198.0	1S/ 9W- 3C6, S 55.7
4-13.09	San Dimas Basin	24	- 5-1/2	1S/ 8W- 6L2, S 325.0	1S/ 9W-11G1, S 40.4
4-13.10	Foothill Basin	6	-12-1/2	1N/ 9W-35Q3, S 249.5	1N/ 9W-25K1, S 35.4
4-13.11	Spadra Basin	11	- 5	1S/ 9W-25G1, S 174.0	1S/ 9W-22J1, S Flowing
4-13.12	Puente Basin	32	+ 1-1/2	2S/10W-14M1, S 58.8	2S/ 9W- 5N3, S 4.2

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
4-14.00	Upper Santa Ana Valley (Los Angeles County)				
4-14.01	Chino Basin	12	+ 2-1/2	1S/ 8W-28G2, S 286.9	1S/ 8W-31J1, S 117.5
4-14.02	Pomona Basin	17	+ 1-1/2	1S/ 8W-20B2, S 492.0	1S/ 9W-11J1, S 0.6
4-14.03	Live Oak Basin	16	+ 3-1/2	1S/ 8W- 7D1, S 221.3	1N/ 8W-32P2, S 62.1
4-14.04	Claremont Heights Basin	21	-17-1/2	1S/ 8W-10B1, S 435.0	1N/ 8W-23J1, S 41.2
4-15.00	Tierra Rejada Valley	10	- 2-1/2	2N/19W-15N2, S 227.7	2N/19W-14P1, S 42.4
4-16.00	Malibu Coastal Group				
4-16.01	Hidden Valley Basin	18	-18	1N/20W-25C5, S 144.2	1N/19W-28M1, S 8.8
4-16.02	Russell Basin	3	-14-1/2	1N/19W-23C1, S 112.0	1N/19W-28A1, S 16.5
4-16.05	Arroyo Sequit Canyon Basin	2	+ 1-1/2	1S/20W-25E2, S 33.8	1S/20W-25E1, S 17.3
4-16.09	Trancas Canyon Basin	4	- 1/2	1S/19W-35F2, S 67.6	1S/19W-35Q2, S 17.8
4-16.10	Zuma Canyon Basin	4	-13	2S/18W- 6E2, S 76.1	2S/18W- 6M2, S 47.9

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
4-16.11	Ramera Canyon Basin	6	0	1S/18W-32P2, S 78.3	2S/18W- 5C2, S 7.7
4-16.14	Solstice Canyon Basin	1	0	1S/18W-34H1, S 44.9	1S/18W-34H1, S 44.3
4-16.16	Malibu Creek Basin	8	+ 2-1/2	1S/17W-30H1, S 87.6	1S/17W-32L5, S 8.9
4-16.19	Las Flores Canyon Basin	1	+ 2-1/2	1S/17W-35E1, S 22.8	1S/17W-26E1, S 14.9
4-16.20	Piedra Gorda Canyon Basin	6	+ 8-1/2	1S/17W-36K1, S 240.5	1S/17W-36H2, S 94.0
4-16.25	Las Virgenes Canyon Basin	1	+ 1/2	1N/17W-31C2, S 37.8	1N/17W-31C2, S 36.0

Area, and Piru and Hidden Valley Basins. Releases of approximately 17,500 acre-feet of water from Lake Piru to the stream bed of the Santa Clara River for delivery to spreading grounds in Piru Basin and the Oxnard Plain Forebay area prevented even larger declines of ground water levels in the basins in the Santa Clara River Valley.

Observed ground water levels in a portion of the Oxnard Plain Forebay area and piezometric levels (that is, the elevation to which ground water would rise in a well perforating an aquifer of confined ground water) throughout most of the Oxnard Plain Pressure area continued to be below sea level. This condition permitted the continued intrusion of sea water into the area. The extent of this intrusion is discussed in detail in Chapter IV.

Observed depths to ground water in Ventura County ranged from flowing at Ojai, to over 540 feet below the ground surface three miles north of Somis in the Las Posas Valley.

In the Coastal Plain of Los Angeles County, ground water levels declined in all basins, varying from a decline of less than one foot in the West Coast Basin to more than eight feet in the Montebello Forebay area. The declines in this area would probably have been considerably greater except for artificial recharge projects which were carried on throughout the year, particularly in the Montebello Forebay area.

Piezometric levels at wells throughout a large portion of the Coastal Plain continued to be below sea level. The lowest elevation of the depression in piezometric levels in the West Coast Basin in the spring of 1960 remained 80 to 90 feet below sea level or about the same depth as recorded one year ago. Observations of piezometric levels as much as 140

feet below sea level were noted east of the Dominguez Hills, in the Central Basin Pressure Area.

Observations of ground water levels in the San Fernando Valley indicated varying changes in ground water levels, ranging from a decline of six feet in the San Fernando Basin, to a rise of over eleven feet in Tujunga Basin. This indicated rise, however, is probably due to a reduction in the quantity of ground water extracted in that area by the Department of Water and Power of the City of Los Angeles, and reflects the tendency of ground water to return to static levels in areas where ground water levels have been depressed by pumping, when such pumping ceases.

Depths to ground water in the San Fernando Valley varied from flowing, about three-fourths of a mile northwest of Reseda, to more than 380 feet below the ground surface at Tujunga.

In the San Gabriel Valley observed ground water level elevations indicated a decline in every basin in the valley, with the exception of the Puente Basin. In the Main San Gabriel Basin, the largest ground water basin in the valley, the average decline was about eight feet, while the Puente Basin in the southern portion of the valley showed a rise of about one and one-half feet. Depths to ground water in the San Gabriel Valley ranged from flowing at the Los Angeles County Arboretum in the Raymond Basin, to more than 425 feet below the ground surface, one mile northeast of Glendora in the Glendora Basin.

In the Los Angeles County area of the Upper Santa Ana Valley, observed ground water levels indicated a rise of about two feet for the year in Chino and Pomona Basins, and a rise of in excess of three feet in Live Oak Basin. During this same period, a decline of approximately 17 feet occurred in the Claremont Heights Basin. This decline was due primarily to a reduction in the amount of water spread in San Antonio Creek.

Lahontan Region (No. 6) -(Southern Portion)

There were only limited changes in the ground water levels in most ground water basins in the Lahontan Region between the spring of 1959 and the spring of 1960. Exceptions to this were a rise of four feet in the Rock Creek Basin and a five foot lowering in Neenach Basin. However, it should be emphasized that only a small number of wells were measured in many of the ground water basins in the Lahontan Region, and the averages of the changes in ground water level elevations may not truly reflect ground water conditions. In the Lancaster Basin, the most developed basin in the region, ground water level measurements at 66 wells indicated a decline of about one foot. During the same period ground water levels in the highly developed Lower Mojave and Harper Valleys declined an average of about two feet and one foot respectively. Observed depths to ground water in this region varied from flowing, six miles east of Lockhart in Harper Valley, to more than 425 feet below the ground surface three miles northeast of Valyermo in the Rock Creek Basin.

All available ground water level data for the Lahontan Region for the 1959-60 season are tabulated in Volume III, Appendix C, and a summary of these data is presented in Table 17. Historical changes in ground water elevations at selected wells in ground water basins in the southern portion of Lahontan Region are given on Plate 12B, and the locations of these wells are shown on Plate 8 "Location of Wells at Which Water Level Fluctuations are Shown -- Lahontan Region (No. 6)".

Colorado River Basin Region (No. 7)

Observed depths to ground water, in those basins for which data are available, indicated no pronounced trend of rise or decline in ground

TABLE 17

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6) (SOUTHERN PORTION) DURING 1959-60

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
6-20.00	Middle Amargosa Valley	1	- 2	22N/ 7E-13L1, S 24.4	22N/ 7E-13L1, S 24.4
6-22.00	Upper Kingston Valley	2	0	16N/12E-26N1, S 46.0	14N/13E-13H1, S 14.4
6-28.00	Pahrump Valley	5	+ 1-1/2	21N/10E-4L1, S 164.3	20S/52E- 6R1, M 10.4
6-29.00	Mesquite Valley	6	+ 1/2	20N/12E-19F1, S 129.3	19N/12E-11B1, S 30.8
6-30.00	Ivanpah Valley	5	+ 2-1/2	15N/15E-13G1, S 368.5	16N/14E-31E1, S 15.3
6-31.00	Kelso Valley	1	+ 1	11N/12E-25G2, S 420.2	11N/12E-25G2, S 420.2
6-33.00	Soda Lake Valley	4	0	14N/ 9E-30G2, S 77.4	12N/ 8E-27X2, S 19.3
6-34.00	Silver Lake Valley	1	0	15N/ 8E-22R1, S 56.0	15N/ 8E-22R1, S 56.0

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6)
(SOUTHERN PORTION)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
6-35.00	Cronise Valley	3	- 1/2	12N/ 7E-30J1, S 48.3	12N/ 7E-18R2, S 15.2
6-37.00	Coyote Lake Valley	5	0	12N/ 2E-31A1, S 55.9	11N/ 2E- 8K1, S Flowing
6-38.00	Caves Canyon Valley	1	+ 2-1/2	11N/ 5E-15G1, S 188.6	11N/ 5E-15G1, S 186.0
6-39.00	Troy Valley	3	+ 1/2	8N/ 4E-12N1, S 32.6	8N/ 3E-4B3, S 8.6
6-40.00	Lower Mojave River Valley	22	- 2	9N/ 1W-10D2, S 148.3	9N/ 3E-19P1, S 10.4
6-41.00	Middle Mojave River Valley	8	- 1-1/2	8N/ 6W-15H1, S 141.7	8N/ 4W-31R1, S 9.7
6-42.00	Upper Mojave River Valley	36	+ 1/2	4N/ 5W-22H1, S 670.8	3N/ 4W-13B1, S 5.1
6-43.00	El Mirage Valley	6	+ 1/2	5N/ 7W- 9H1, S 285.7	6N/ 7W-12N1, S 20.4

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6)
(SOUTHERN PORTION)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
6-44.00	Antelope Valley				
6-44.01	Neenach Basin	10	- 5	8N/15W-33G1, S 285.0	8N/16W-26G1, S 6.9
6-44.02	Willow Springs Basin	5	0	11N/13W-29M1, S 335.0	9N/13W- 7Q1, S 26.8
6-44.04	Chaffee Basin	2	- 2	11N/11W- 8D1, S 198.1	11N/12W-26J1, S 160.6
6-44.05	Lancaster Basin	66	- 1	6N/12W-24C1, S 315.9	5N/12W- 2K1, S 2.0
6-44.06	Buttes Basin	3	- 2-1/2	6N/11W-21E1, S 275.4	5N/12W-12A2, S 12.1
6-44.07	Rock Creek Basin	6	+ 4	5N/ 9W-34D1, S 425.0	4N/ 9W- 6Q1, S 6.3
6-44.08	North Muroc Basin	4	0	11N/ 8W-35D1, S 174.3	10N/ 9W-24A2, S 72.7
6-46.00	Fremont Valley	9	- 1	31S/37E-22Q1, M 298.2	30S/37E-36G1, M 40.6
6-47.00	Harper Valley	17	- 1/2	10N/ 5W- 3J1, S 225.3	11N/ 3W-30A1, S Flowing

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6)
(SOUTHERN PORTION)
DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
6-49.00	Superior Valley	2	+ 1/2	31S/45E- 1C1, M 117.5	31S/46E- 2M1, M 99.0
6-50.00	Cuddeback Valley	3	+ 1/2	30S/42E-24L1, M 147.5	31S/42E- 5R1, M 57.9
6-54.00	Indian Wells Valley	2	- 2	26S/39E-20Q1, M 218.7	26S/40E-28J1, M 106.1

water levels throughout the region. However, in most of the ground water basins for which data are available only a few wells were measured, so that the indicated values may not truly reflect the actual ground water conditions. In Coachella Valley an average rise in ground water levels of about 2.5 feet was observed. A rise of 6.5 feet was noted in Fenner Valley; however, this was based on observations made at only three wells. Depths to ground water in the Colorado River Basin Region varied from flowing wells located in the Coachella Valley southeast of the town of Coachella, to more than 520 feet below the ground surface in a well located about one mile northeast of Palm Springs.

All available ground water level data for the Colorado River Basin Region for the period July 1959 through June 1960 are tabulated in Volume 3, Appendix D, and summarized by ground water basin in Table 18. The historical ground water levels for well 10S/6E-21A1 located in Borego Valley, are represented by a hydrograph on Plate 12B. The location of this well is shown on Plate 9 "Location of Wells at Which Water Level Fluctuations are Shown -- Colorado River Basin Region (No. 7)".

<u>Santa Ana Region (No. 8)</u>

Ground water level elevations in the Santa Ana Region declined in 16 of 23 basins between the spring of 1959 and the spring of 1960, reflecting the effects of another subnormal precipitation year. Artificial recharge activities apparently impeded the rate of decline in some areas and caused a rise in ground water levels in other areas.

Available ground water level measurements for the Santa Ana Region for the period July 1959 through June 1960 are tabulated in Volume III, Appendix E, and the estimated average change in ground water level elevations

TABLE 18

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN COLORADO RIVER BASIN REGION (NO. 7) DURING 1959-60

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
7-1.00	Lanfair Valley	7	+ 1	12N/17E-17J1, S 430.6	14N/16E-22M1, S 15.3
7-2.00	Fenner Valley	3	+ 6-1/2	7N/15E-35R1, S 337.0	6N/16E- 6K1, S 258.1
7-5.00	Chuckawalla Valley	4	- 2-1/2	5S/16E-25F1, S 139.8	4S/17E- 6C1, S 21.9
7-8.00	Bristol Valley	2	+ 1/2	5N/14W-15L1, S 211.3	6N/12E-29P1, S 149.9
7-9.00	Dale Valley	7	+ 1-1/2	1N/10E-36P1, S 333.9	1N/12E-21L1, S 9.9
7-10.00	Twentynine Palms Valley	38	0	1N/ 8E-11L1, S 376.6	2N/ 9E-30A2, S 0.3
7-11.00	Copper Mountain Valley	6	- 1/2	1N/ 7E-30P1, S 368.7	1N/ 7E-26N1, S 169.1
7-12.00	Warren Valley	4	- 2	1N/ 6E-29R2, S 258.2	1S/ 5E- 4R2, S 61.7
7-12.00	Deadman Valley	2	- 1	1N/ 6E- 4Q1, S 457.0	1N/ 6E- 9Q2, S 262.5

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN COLORADO RIVER BASIN REGION (NO. 7) DURING 1959-60 (continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
7-18.00	Johnson Valley	2	0	4N/ 3E-24Q1, S 55.3	4N/ 4E-19C1, S 45.2
7-19.00	Lucerne Valley	22	+ 1	6N/ 1E-31Q1, S 228.5	4N/ 1W-14B1, S Flowing
7-20.00	Morongo Valley	4	- 1/2	1S/ 4E-14N1, S 184.0	1S/ 4E-33C1, S 5.3
7-21.00	Coachella Valley	39	+ 2-1/2	3S/ 4E-30C1, S 529.0	6S/ 8E- 5R1, S Flowing
7-24.00	Borrego Valley	9	- 2-1/2	10S/ 6E- 8B1, S 265.5	9S/ 6E-36A1, S 16.6
7-25.00	Ocotillo Valley	1	- 2-1/2	12S/ 8E-22E1, S 108.6	12S/ 8E-22E1, S 108.6
7-27.00	San Felipe Valley	1	+ 5-1/2	12S/ 5E-34J1, S 64.0	12S/ 4E-24K1, S 22.4

for selected ground water basins is presented in Table 19. Hydrographs of wells, which indicate long-term water level fluctuations in the region, are delineated on Plate 12B, and the location of these wells is shown on Plate 10 "Location of Wells at Which Water Level Fluctuations are Shown -- Santa Ana Region (No. 8)".

About 173,000 acre-feet of imported Colorado River water were spread for ground water replenishment in the Santa Ana Forebay ground water basin of Coastal Orange County during the 1959-60 water year. This represents an increase of about 100,000 acre-feet over the amount of imported water spread during the previous year. As a result of this activity, the average ground water level in this basin rose two and one-half feet between the spring of 1959 and the spring of 1960.

In the Irvine Basin an average increase of seven feet in the ground water levels was observed. This increase was primarily due to the increased use of surface deliveries of Colorado River water with a consequent decrease in ground water extractions, and to the spreading of 880 acre-feet of imported water.

The maximum observed depth to ground water in Orange County was about 350 feet, at a well located about two miles northeast of Orange in the Santa Ana Forebay Area of the Coastal Plain. Minimum depth to water of about 4 feet below the ground surface was observed at a well about 2 miles northwest of Newport Heights in the East Coastal Plain Pressure Area.

In the East Coastal Plain Pressure Area of Orange County, the average of observed piezometric levels remained unchanged despite the extensive spreading operations in the Santa Ana Forebay. The levels remained below sea level throughout most of the basin, reaching a maximum of about

TABLE 19

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN SANTA ANA REGION (NO. 8) DURING 1959-60

	Hydrologic unit or basin	Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Location and observed extremes of depth to ground water during 1959-60, in feet: Minimum
8-1.00	Coastal Plain (Orange County)				
8-1.01	East Coastal Plain Pressure Area	131	0	5S/ 9W-35J1, S 174.8	6S/10W-20M1, S 3.8
8-1.02	Santa Ana Forebay Area	75	+ 2-1/2	4S/ 9W-22R1, S 349.9	4S/ 9W- 4G1, S 15.9
8-1.03	Irvine Basin	17	+ 7	6S/ 8W- 5E2, S 291.5	5S/ 9W-15R3, S 45.4
8-1.04	La Habra Basin	7	+ 1/2	3S/10W- 7Q1, S 174.3	3S/10W-10N1, S 23.0
8-1.05	Yorba Linda Basin	3	- 1	3S/ 9W-23K1, S 191.8	3S/ 9W-34C1, S 13.9
8-1.06	Santa Ana Narrows Basin	78	0	3S/ 9W-33K6, S 75.1	3S/ 7W-20L1, S 3.8
8-2.00	Upper Santa Ana Valley				
8-2.01	Chino Basin	169	- 1	1S/ 8W-12H1, S 584.0	2S/ 8W-36Q1, S 2.6
8-2.02	Claremont Heights Basin	16	-36-1/2	1N/ 8W-35J2, S 403.5	1S/ 8W- 2M3, S 59.5
8-2.03	Cucamonga Basin	16	+ 2	1N/ 7W-29R3, S 507.0	1S/ 7W- 4E2, S 190.5
8-2.04	Rialto Basin	10	-22-1/2	1N/ 5W-29A1, S 476.4	2N/ 6W-26L1, S 29.2
8-2.05	Colton Basin	33	- 2-1/2	1S/ 5W- 5A2, S 307.9	1S/ 4W-22B6, S 19.0

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN SANTA ANA REGION (NO. 8) DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
8-2.06	Bunker Hill Basin	171	- 3	1N/ 3W-28P1, S 426.2	1S/ 4W-22H4, S Flowing
8-2.07	Lytle Basin	13	-23	1N/5W- 15Q1, S 340.3	1N/ 5W-23P4, S 120.0
8-2.10	Devil Canyon Basin	5	- 8	1N/ 4W- 8P1, S 242.0	1N/ 4W-14R8, S 13.3
8-2.12	Beaumont Basin	16	- 1-1/2	3S/ 1W-3K3, S 410.4	2S/ 1W- 2J1, S 6.9
8-2.13	San Timoteo Basin	15	- 4	1S/ 3W-24R1, S 329.1	2S/ 2W-20K1, S 35.7
8-2.15	Riverside Basin	60	- 2	1S/ 5W-34D1, S 226.0	2S/ 5W-20A2, S 6.1
8-2.16	Arlington Basin	6	- 1/2	3S/ 6W-23H1, S 51.8	2S/ 5W-31N1, S 6.3
8-2.17	Temescal Basin	58	+ 1/2	3S/ 7W-35C1, S 193.3	3S/ 7W-21M3, S 1.9
8-2.18	Bedford Basin	4	+ 9	4S/ 6W-16C2, S 72.9	4S/ 6W-35G1, S 30.1
8-2.19	Coldwater Basin	7	-37-1/2	5S/ 6W- 3Q1, S 223.6	5S/ 6W- 2P1, S 103.1
8-2.20	Lee Lake Basin	3	- 2-1/2	5S/ 5W- 8P1, S 64.1	5S/ 5W- 7C1, S 10.5
8-4.00	Elsinore Valley	54	- 2	5S/ 5W-34K1, S 334.1	6S/ 4W-28L1, S 7.0
8-5.00	San Jacinto Valley	31	- 4-1/2	5S/ 1E- 7K1, S 292.8	4S/ 1W-18L1, S 7.1

50 feet below sea level near the Orange County-Los Angeles County line. The continued existence of a gradient in the pressure surface downward inland from the coast provides conditions favorable for the intrusion of sea water. A further discussion of sea water intrusion in Orange County is presented in Chapter IV.

In the larger basins in the Upper Santa Ana Valley the ground water levels declined an average of one to four feet. In the northwestern portion of the Chino Basin about one mile west of Upland, ground water levels were more than 580 feet below the ground surface, while in the southwestern portion of the basin, about three miles southeast of Los Serranos, the depth to water from the ground surface was less than three feet. Spreading operations were carried on in the Upper Santa Ana Region with about 13,000 acre-feet of local water spread at twelve projects.

Ground water level elevations in a number of the smaller peripheral basins located adjacent to the San Gabriel mountains in the Upper Santa Ana Valley showed substantial declines. For example, in Claremont Heights Basin an average decline of 36 feet was noted, while in Lytle and Rialto Basins the declines were 23 and 22 feet respectively.

Ground water levels in the San Jacinto Valley continued to decline with an average drop of more than four feet being noted. Depths to ground water varied from a maximum of more than 290 feet two miles southeast of San Jacinto, to a minimum of seven feet below the ground surface south of Casa Loma. A hydrograph for well 4S/1W-35Q1 in the San Jacinto Valley, depicting the historical changes in ground water elevations, is presented on Plate 12B.

San Diego Region (No. 9)

Observed ground water levels in the San Diego Region indicate that average ground water elevations have declined in most basins. A significant exception was in Warner Valley, where observed ground water levels indicated a seventeen foot rise between the spring of 1959 and the spring of 1960. This rise can be attributed in part to a reduction in the quantity of ground water extracted in that area by the Vista Irrigation District.

Ground water elevations remained below sea level at a number of wells in the Mission Basin of the San Luis Rey River Valley and in the Tia Juana Basin, inviting further sea water intrusion in those basins. Ground water supply conditions in the vicinity of San Clemente continued to be critical, with sea water intrusion threatening to increase to a point where ground water would not be potable.

Available ground water level measurements for the San Diego Region, July 1959 through June 1960, are tabulated in Volume III, Appendix F, and pertinent statistics regarding ground water conditions are summarized in Table 20. Hydrographs of ground water levels at selected wells in Region 9 are presented on Plate 12B, and the locations of these wells are shown on Plate 11, "Location of Wells at which Water Level Fluctuations are Shown - San Diego Region (No. 9)."

Artificial Recharge

The replenishment of ground water basins by artificial recharge, as a means of conserving surface runoff and regulating imported water, is widely practiced in Southern California. During the 1959-60 water year a total of approximately 273,000 acre-feet of local and imported water was reported as being spread or injected at 51 projects. Approximately 211,000

TABLE 20

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN SAN DIEGO REGION (NO. 9) DURING 1959-60

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
9-1.00	San Juan Valley				
9-1.01	Aliso Creek Basin	7	+ 1	6S/ 8W-26F4, S 73.4	6S/8W-24M1, S 10.2
9-1.02	San Juan Creek Basin	51	- 4-1/2	7S/ 8W-25B2, S 65.4	8S/ 8W-13D1, S 4.4
9-5.00	Temecula Valley				
9-5.01	Murrieta Basin	7	- 4-1/2	6S/ 4W-27M1, S 146.9	8S/ 3W-13K1, S 14.0
9-5.02	Pauba Basin	3	- 3	8S/ 2W-12H1, S 65.2	8S/ 2W-11L1, S 33.8
9-5.03	Wolf Basin (Pechanga)	1	0	8S/ 2W-20E1, S 17.9	8S/ 2W-20E1, S 17.4
9-7.00	San Luis Rey Valley				
9-7.01	Mission Basin	8	+ 1-1/2	11S/ 4W-18C4, S 81.7	11S/ 5W-13N2, S 24.0
9-7.02	Bonsall Basin	36	- 2-1/2	10S/ 1W-23K5, S 211.3	10S/ 3W-20E1, S 9.0
9-8.00	Warner Valley	32	+17-1/2	10S/ 2E-24Q1, S 187.0	11S/ 3E- 7A1, S 12.1

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN SAN DIEGO REGION (NO. 9) DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet: Maximum	Minimum
9-10.00	San Pasqual Valley				
9-10.01	Lake Hodges Basin	5	- 1	13S/ 2W- 3K1, S 94.0	13S/ 1W- 7E2, S 10.5
9-10.02	San Pasqual Basin	45	- 4	12S/ 1W-25N2, S 47.9	12S/ 1W-32N1, S 7.0
9-10.03	Felicita Basin	18	- 1-1/2	12S/ 2W-28P1, S 119.8	12S/ 2W-24R3, S 1.9
9-10.04	Green Basin	1	+ 5	13S/ 1W-31K1, S 40.1	13S/ 2W-26H2, S 33.5
9-10.05	Highland Basin	2	+ 8-1/2	13S/ 1W- 5L1, S 39.3	13S/ 1W- 5L1, S 21.5
9-10.06	Pamo Basin	3	- 2	12S/ 1E- 2L1, S 20.9	12S/ 1E- 2P2, S 8.7
9-10.08	Santa Ysabel Basin	1	- 1/2	12S/ 3E-16C2, S 15.6	12S/ 3E-21N1, S 3.0
9-11.00	Santa Maria Valley				
9-11.01	Ramona Basin	21	- 1	12S/ 1E-34Q1, S 63.1	13S/ 1W-24K1, S 5.4
9-11.05	Santa Teresa Basin	1	- 7	12S/ 2E-32G1, S 21.8	13S/ 2E- 3E1, S 19.9
9-11.06	Ballena Basin	2	- 2-1/2	13S/ 2E-10K1, S 19.8	13S/ 2E-11C1, S 12.9

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN SAN DIEGO REGION (NO. 9) DURING 1959-60
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1959-60, in feet	
				Maximum	Minimum
9-12.00	San Dieguito Valley				
9-12.01	San Dieguito Basin	8	- 3	13S/ 3W-33D1, S 65.1	14S/ 4W-11J2, S 5.8
9-15.00	San Diego River Valley	13	- 9-1/2	15S/ 1E- 2P2, S 73.0	15S/ 1E-20B4, S 19.0
9-17.00	Sweetwater Valley	26	- 2	16S/ 1E-29N1, S 22.6	17S/ 2W-25P2, S 3.5
9-19.00	Tia Juana Valley	47	- 1-1/2	1S/ 2W-27R2, S 85.8	18S/ 2W-32P7, S 6.9

acre-feet of this amount, or about 77 percent, consisted of imported Colorado River water, emphasizing once again the shortage of local surface runoff.

Artificial recharge activities were instrumental in minimizing or delaying further decreases in ground water levels in a number of basins. The measured or estimated amounts of water spread at the various projects for which there were quantitative reports of activity during the 1959-60 water year are tabulated in Table 21.

TABLE 21

SUMMARY OF PRINCIPAL ARTIFICIAL RECHARGE ACTIVITIES IN SOUTHERN CALIFORNIA DURING 1959-60 WATER YEAR

Hydrologic Unit	Areal Designation Code Number	Agency conducting spreading operation[a]	Number of projects operated	Reported or estimated amount spread, in acre-feet
Ojai Valley	4- 2.00	VCFCD	1	5
	4- 4.01	UWCD	1	170
Santa Clara River Valley	4- 4.00			
Oxnard Plain Forebay Area	4- 4.02	UWCD	2	13,100
Piru Basin	4- 4.06	UWCD	1	3,440
Coastal Plain, Los Angeles County	4-11.00			
West Coast Basin	4-11.02	LACFCD	2	3,700[b]
Montebello Forebay Area	4-11.05	LACFCD	3	44,600[c]
San Fernando Valley	4-12.00			
San Fernando Basin	4-12.01	LACFCD	3	390
		LADW&P	1	8,040
Tujunga Basin	4-12.05	LACFCD	1	0
San Gabriel Valley	4-13.00			
Main San Gabriel Basin	4-13.01	LACFCD	7	4,810
Monk Hill Basin	4-13.02	LACFCD	1	0
Pasadena Subarea	4-13.03	LACFCD	1	0
Santa Anita Subarea	4-13.04	LACFCD	1	810
		CSMWD	1	35
Upper Canyon Basin	4-13.05	DMWC	1	4,370[d]
		SGRSC	1	6,110
Glendora Basin	4-13.07	GIC	1	0
		LACFCD	1	0
Upper Santa Ana Valley, Los Angeles County	4-14.00			
Claremont Heights Basin	4-14.04	PVPA	2	0
		CPWD	1	960
Coastal Plain, Orange County	8- 1.00			
Santa Ana Forebay Area	8- 1.02	OCWD	1	151,240[e]
		OCWD & SAVIC	1	9,940[e]
		AUWC	2	8,750[f]
		OCFCD	1	630
Irvine Basin	8- 1.03	OCWD	3	870[e]
Yorba Linda Basin	8- 1.05	AUWC	1	1,610
Santa Ana Narrows Basin	8- 1.06	AUWC	1	630[g]

SUMMARY OF PRINCIPAL ARTIFICIAL RECHARGE ACTIVITIES
IN SOUTHERN CALIFORNIA DURING 1959-60 WATER YEAR
(continued)

Hydrologic Unit	Areal Designation Code Number	Agency conducting spreading operation[a]	Number of projects operated	Reported or estimated amount spread, in acre-feet
Upper Santa Ana Valley	8- 2.00			
Chino Basin	8- 2.01	SBCFCD	2	210
		EWC	2	640
Cucamonga Basin	8- 2.03	SAWC & SBCFCD	1	1,390
		SBCFCD	1	25
Bunker Hill Basin	8- 2.06	SBVWCD	3	3,900
		SBCFCD	1	200
Lytle Basin	8- 2.07	FUWC	1	600
Devil Canyon Basin	8- 2.10	SBCFCD	1	1,440
Beaumont Basin	8- 2.12	RCFC&WCD	1	0
Temescal Basin	8- 2.17	RCFC&WCD	1	0
Coldwater Basin	8- 2.19	TWC	2	210
Lee Lake Basin	8- 2.20	TWC	2	90
San Jacinto Valley	8- 5.00	RCFC&WCD	1	20
Total local and imported water reported spread				272,935
Total imported water reported spread				211,000
Total local water reported spread				61,935

a. Abbreviations of agencies conducting spreading operations are presented in alphabetical order: AUWC-Anaheim Union Water Company; CPWD-City of Pomona Water Department; CSMWD-City of Sierra Madre Water Department; DMWC-Duarte Mutual Water Company; EWC-Etiwanda Water Company; FUWC-Fontana Union Water Company; GIC-Glendora Irrigation Company; LACFCD-Los Angeles County Flood Control District; LADW&P-Los Angeles Department of Water and Power; OCFCD-Orange County Flood Control District; OCWD-Orange County Water District; PVPA-Pomona Valley Protective Association; RCFC&WCD-Riverside County Flood Control and Water Conservation District; SAWC-San Antonio Water Company; SBCFCD-San Bernardino County Flood Control District; SBVWCD-San Bernardino Valley Water Conservation District; SGRSC-San Gabriel River Spreading Corporation; SAVIC-Santa Ana Valley Irrigation Company; TWC-Temescal Water Company; UWCD-United Water Conservation District; VCFCD-Ventura County Flood Control District.

b. Total quantity is softened Colorado River water.

SUMMARY OF PRINCIPAL ARTIFICIAL RECHARGE ACTIVITIES
IN SOUTHERN CALIFORNIA DURING 1959-60 WATER YEAR
(continued)

c. Includes approximately 37,330 acre-feet of unsoftened Colorado River water diverted to spreading grounds. An additional volume of approximately 36,060 acre-feet was purchased. This volume percolated in the unlined portions of the Rio Hondo and the San Gabriel River between the points of release and the points of diversion to the spreading grounds.
d. Amount reported September 1959 through August 1960 only.
e. Total quantity is unsoftened Colorado River water.
f. Includes about 7,660 acre-feet of unsoftened Colorado River water.
g. Includes about 90 acre-feet of unsoftened Colorado River water.

CHAPTER IV. QUALITY OF WATER AND SEA-WATER INTRUSION

During the 1959-60 season, the principal water quality problem in Southern California continued to be the intrusion of sea water in coastal ground water basins. During this period, the saline fronts advanced in most areas under surveillance. The following sections present summary information on quality of surface and ground waters, and on the current status of sea water intrusion.

Water Quality

Results of mineral analyses of surface and underground waters vary considerably within the various basins, making detailed evaluations of changes from year to year increasingly complex. Comprehensive evaluations of water quality changes are presented in the Department of Water Resources Bulletins, series No. 65, "Quality of Surface Waters of California", and series No. 66, "Quality of Ground Waters in California".

For the purpose of this report, mineral analyses of water samples collected during 1959-60 at selected surface and underground points in Southern California were compiled. These analyses are presented in Tables 22 and 23 and are intended to give only a general indication of water quality.

Sea-Water Intrusion

The movement of sea water into the fresh-water aquifers of a number of the coastal ground water basins in Southern California continued during 1959-60. The Oxnard Plain Pressure Area of Ventura County, the West Coast Basin of Los Angeles County, and the Coastal Area of Orange

TABLE 22

MINERAL ANALYSES OF SURFACE WATER AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA

Station number	Station	Date sampled and estimated discharge	$EC \times 10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
37-121.7	Salinas River, USGS gage at old State Highway 41 bridge at Paso Robles	6-9-60 2 cfs	1,310	101	50	102.6	329	253	96	1.6	0.30	457	31
318-35.5	Santa Ynez River at Mission Bridge 0.9 mile S. of Solvang	5-5-61 15 est.	1,125	75	71	57.2	332	257	41	0.46	0.34	476	20
42-5.7	Ventura River, N. of Ventura, in Foster Memorial Park, 300 feet downstream from highway bridge, at USGS gaging station	5-2-60 405 cfs	1,500	113	35	61.9	242	268	54	1.3	0.53	427	23
43-17.0	Santa Clara River, E. of Santa Paula and about 1.5 miles upstream from Willard Bridge	5-2-60 35 cfs	1,245	229	96	206	312	971	93	10	1.08	966	31
47-23.9	Los Angeles River NE. of Los Angeles at Figueroa Street	5-10-60 0.06 cfs	1,440	87	48	298	120	623	365	0	1.22	416	67

MINERAL ANALYSES OF SURFACE WATER AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA
(continued)

Station number	Station	Date sampled and estimated discharge	$ECx10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
47-12.2-9.6	Rio Hondo, N.E. of Montebello, about 0.1 mile upstream from San Gabriel Blvd. bridge	5-3-60 18.0 cfs	935	58	18	95.3	196	162	58	3.4	0.15	220	47
48-20.7	San Gabriel River, S.W. of El Monte and 0.5 mile upstream from Whittier Narrows Dam	5-3-60 64 cfs	1,030	69	19	69	181	160	55	2.9	0.16	251	35
82-57.9-2.0	Warm Creek, San Bernardino at "E" Street		Station dry at all times visited during 1959-60 season										
82-45.2	Santa Ana River, Pedley Bridge N. of Arlington	5-3-60 23 cfs	1,505	113	19	83	339	100	98	19	0.12	360	32
93-20.0	Santa Margarita River, N. of Fallbrook, about 0.5 mile downstream from confluence with Sandia Creek	5-2-60 3 cfs est.	1,005	86	24	129	290	125	137	0.0	0.26	313	46

MINERAL ANALYSES OF SURFACE WATER AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA
(continued)

Station number	Station	Date sampled and estimated discharge	$ECx10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Per-cent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
94-28.0	San Luis Rey River, S.E. of Pala at Pala Diversion Dam	1-11-60 1/40 est.	1,430	70	26	57	161	179	51	0.0	0.0	281	28
620A-28.8	Big Rock Creek, S.E. Pearblossom and about 300 feet up-stream from con-fluence with Pallett Creek	2-10-60	598	64	25	33	179	149	13	5	0.24	267	17
619-95	Mojave River, N.W. of Victorville, about 0.2 mile S.E. of U. S. Highway 91 bridge	5-3-60 27 cfs	1,810	40	9.5	43	190	32	28	2.6	0.07	139	39

TABLE 23

MINERAL ANALYSES OF GROUND WATER AT
SELECTED WELLS IN SOUTHERN CALIFORNIA

State well number	Owner and location	Date sampled	$EC \times 10^6$ at 25^oC	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
	Central Coastal Region												
	Santa Maria River Valley												
10N/34W-19H1	Union Sugar Co.; 1.0 mile N. of Betteravia Road on Black Road, just W. of Black Road	9-29-59	1,743	145	67	89	256	455	97	24	0.46	636	22
	Lompoc Subarea, Santa Ynez River Valley												
7N/35W-26F4	Union Sugar Co.; 300' N. of Central Ave. produced 100' W. of Union Sugar Ave.	4- 5-60	2,182	198	112	119	495	416	273	3	0.46	956	20
	Los Angeles Region												
	Oxnard Plain Pressure Area, Santa Clara River Valley												
1N/22W- 3F4	City of Oxnard; 200' E. of Saviers Road, 100' N. of Third Street	12- 9-60	1,490	--	--	--	293	--	60	--	--	636	--

MINERAL ANALYSES OF GROUND WATER AT
SELECTED WELLS IN SOUTHERN CALIFORNIA
(continued)

State well number	Owner and location	Date sampled	$EC \times 10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Per-cent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
				Los Angeles Region (continued)									
Oxnard Plain Forebay Area, Santa Clara River Valley													
2N/22W-12G1	United Concrete Pipe Corporation; One mile S.E. of Saticoy, 200' N.E. of Del Norte Avenue, 500' S.E. of Vineyard Avenue	9-30-59	1,552	142	69	134	266	544	82	2	0.55	640	30
Central Coastal Plain Pressure Area, Coastal Plain (Los Angeles County)													
3S/12W- 8F1	Los Angeles County Farm; Two miles S.W. of Downey, 1,600' S. and 300' W. of intersection of Imperial Hwy. and County Farm Road	7- 7-60	511	55	13	31	235	38	19	0.3	0.12	191	24
Montebello Forebay Area, Coastal Plain (Los Angeles County)													
2S/11W-19L1	La Habra Heights Mutual Water Company, Judson No. 3 well; Two miles W. Whittier, 1,050' W. of Norwalk Blvd., 1,600' from Dunlap Crossing along road	8-17-59	847	110	22	49	226	166	62	13	--	366	--

MINERAL ANALYSES OF GROUND WATER AT
SELECTED WELLS IN SOUTHERN CALIFORNIA
(continued)

State well number	Owner and location	Date sampled	$EC \times 10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Per-cent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
	Los Angeles Region (continued)												
San Fernando Basin, San Fernando Valley													
1N/14W-14B1	City of Burbank; 35' N.E. of Lake St. 40' N.W. of Orange Grove Ave.	9- 2-60	458	--	--	--	198	--	22	--	--	161	--
Main San Gabriel Basin, San Gabriel Valley													
1S/11W- 2G2	City of Monrovia; three miles S. of Monrovia, 420' E. of Peck Rd., 110' N. of Jeffries Avenue	4-18-60	505	67	15	15	235	26	14	30	0.01	230	12
Pasadena Subarea, San Gabriel Valley													
1N/12W-20B1	City of Pasadena, Copelin Well; Pasadena, 142' E. of Mentone Avenue, 118' N. of Manzanita Street	6- 1-59	--	59	19	22	210	58	28	11.3	--	223	17

MINERAL ANALYSES OF GROUND WATER AT
SELECTED WELLS IN SOUTHERN CALIFORNIA
(continued)

State well number	Owner and location	Date sampled	$ECx10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Per-cent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
	Lahontan Region												
Lancaster Basin, Antelope Valley													
8N/13W-32N1	Pedro Lizarraga; 100' E. of 90th Street W. and 100' N. of Avenue "G"	7- 9-59	569	--	--	--	200	--	50	--	--	170	--
	Santa Ana Region												
Anaheim Basin Pressure Area, Coastal Plain (Orange County)													
4S/11W-36N1	Mountain Properties, Inc.; Three miles W. of Garden Grove, 125' S. of Stanford Avenue, 258' E. of Sycamore Street	12-28-59	495	59	10	33	212	43	24	2.5	0.06	187	26
Chino Basin, Upper Santa Ana Valley													
1S/ 7W-21D1	City of Ontario, No. 4 well; Two miles N.E. of Ontario; 90' S. of 4th St., 300' E. of Grove Avenue	5-24-60	330	39	9	21	171	19	9	5.6	0.06	135	24

MINERAL ANALYSES OF GROUND WATER AT
SELECTED WELLS IN SOUTHERN CALIFORNIA
(continued)

State well number	Owner and location	Date sampled	$EC \times 10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Per-cent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
				Santa Ana Region (continued)									
Bunker Hill Basin, Upper Santa Ana Valley													
1S/ 4W-15M2	Meeks and Daley Water Company; 0.7 mi. S. of Mill St., 100' W. of "E" St.	12-23-59	556	69	12	38	251	61	14	0	0.04	220	25
				San Diego Region									
Mission Basin, San Luis Rey River Valley													
11S/ 4W-18C1	S. Davies; 2,900' N.E. from ppg. plt., along Hwy. 76, 1,760' N.W. along private road, 15' S.W. of road	4- 1-60	1,568	116	34	173	274	160	301	0	0.20	430	45
Tia Juana Valley													
19S/ 2W- 4A5	California Water and Telephone Company, Well No. 5; South Basin Plant. 720' W. of National Ave., 1,500' S. of Sunset Avenue	10-21-59	2,170	124	50	268	329	220	422	0	0.36	513	52

County are the major basins experiencing this problem. The status of sea-water intrusion within each of these basins is discussed in this section. A description of the location and hydrologic features of these basins, as well as the history of sea-water intrusion and the corrective measures undertaken, may be found in Bulletin No. 39-57, Volume I, of this series of reports. A detailed study of sea-water intrusion in California is reported in Department of Water Resources Bulletin No. 63, "Sea Water Intrusion in California", November 1958.

In addition to the ground water basins indicated above, several smaller basins are confronted by an imminent threat to ground water quality by sea-water intrusion. These include Morro and Chorro Basins in San Luis Obispo County; Malibu Creek and Trancas Basins in Los Angeles County; San Mateo Basin near San Clemente in Orange County; and in San Diego County, Mission Basin in San Luis Rey River Valley, and the San Dieguito Basin, and Tia Juana Basin. In all of these areas the ground water levels continued to indicate a downward slope inland for some distance during 1959-60. The amount and nature of sea-water intrusion depended on the size of the ground water basin, the extent of ground water extractions, and the length of time the ground water levels have been below sea level. In certain smaller basins the water users have had to curtail pumping to forestall further damage to the limited water supplies. Nevertheless, this action has not been completely successful, and ground water table elevations below sea level are inducing an advance of the sea-water intrusion front toward inland wells in most of these areas.

Oxnard Plain Pressure Area, Ventura County

Mineral analyses of water from wells in this area indicated that chloride ion concentrations exceeded 500 parts per million (ppm) during the spring of 1960. Isochlors, or lines of equal chloride ion concentration, outlining areas of the Oxnard Plain Pressure Area with 100 and 500 ppm concentrations are presented on Plate 13, "Generalized Status of Sea Water Intrusion--Oxnard Plain Pressure Area--Spring 1960". Ground water level contours for June 1960 are also shown on this plate. These data indicate that movement of sea water has generally been landward during the past year, with significant intrusion continuing in two areas, centering around Port Hueneme and Mugu Lagoon.

Near Port Hueneme, intrusion continued to advance inland in the area between Hueneme and Pleasant Valley Roads. The lines of 100 ppm and 500 ppm chlorides moved eastward as much as 1,500 feet during the past year, to form an apparent bulge in this area. It is noted on Plate 13 that the ground water level contours indicate a downward gradient, inland from the ocean which accounts for the rapid advance of sea water in that direction. Also, in the western portion of the Naval Reservation the isochlor lines advanced northward as much as 1,000 feet during the past year. In summary, the area underlain by sea water increased considerably. The maximum landward advance of the 500 ppm isochlor line is 1.9 miles in the easterly direction along Pleasant Valley Road.

Fluctuations of the chloride content in ground water from well 1N/22W-28A2, located near Port Hueneme, for the period 1956 through 1960, are presented graphically on Plate 14 "Fluctuations of Chloride Ion Concentration in Selected Wells".

In the vicinity of Mugu Lagoon, and especially within the confines of the Naval Reservation, the absence of water wells prevents the acquisition of essential data, so the extent of intrusion cannot be accurately determined. Recently, in the southern part of Section 36 (1N/22W-36), the chlorides in the waters produced from the wells have increased significantly, providing the first positive evidence of a moving saline front in the vicinity of Point Mugu.

To the south and west of Hueneme and Arnold Roads, there exists an apparently isolated area of about 200 acres where wells produce ground waters with chloride content ranging up to 560 ppm. The source of these saline waters has not as yet been determined.

West Coast Basin, Los Angeles County

Sea water has intruded the fresh-water aquifers of the West Coast Basin along the entire coast line bordering on Santa Monica Bay, from Palos Verdes Hills to Ballona Gap. Lines of equal chloride concentration of 250, 500, and 1,000 ppm for the spring of 1960 are delineated on Plate 15 "Generalized Status of Sea Water Intrusion - West Coast Basin - Spring 1960". Ground water level contours for June 1960 are also shown on this plate.

In the spring of 1960, the 500 ppm isochlor was located an average distance of 1.3 miles inland from the coast. The 250 ppm isochlor line was approximately 1,000 feet farther inland. Near the cities of Manhattan Beach and El Segundo, both the 250 and 500 ppm chloride lines evidenced little change from the previous spring.

A series of fresh water injection wells, located about one-half mile inland between Manhattan Beach Boulevard and Redondo Beach Boulevard, were again in operation during the year under the auspices of the West Coast

Basin Barrier Project. The isolated body of injected fresh water, landward of the wells, enlarged slightly at the northern end of the injection line.

The isochlor lines in the Redondo Beach area moved landward from their previous year's location as reflected by the continuing increase of chlorides in the intruded wells. The isochlor lines along other portions of the sea-water intrusion front remain in the same positions for 1960 as in 1959.

Fluctuations of the chloride content of water from well 3S/15W-21G1 in Manhattan Beach are shown for the period 1953 through 1960 on Plate 14.

East Coastal Plain Pressure Area, Orange County

Lines of equal chloride ion concentrations of 50, 100, and 500 ppm for the East Coastal Plain Pressure Area for the spring of 1960 are delineated on Plate 16 "Generalized Status of Sea Water Intrusion - East Coastal Plain Pressure Area - June 1960". Ground water level contours for the Talbert Zone in Santa Ana Gap and the upper zone under Bolsa Chica Mesa for June 1960 are also shown on this plate.

Sea water has intruded a sizable area of the Talbert water-bearing zone in Santa Ana Gap, and landward movement continued during the last year. The 500 ppm icochlor line advanced approximately 1,000 feet and is now about 3.1 miles inland from the coast. The chloride ion concentration in wells along the intrusion front continues to increase.

The upper water-bearing zone underlying Bolsa Chica Mesa is being slowly intruded by sea water and/or oil field brines. This advance is indicated by increases in chloride content in the ground water occurring as far as one-half mile to the landward side of the Newport-Inglewood fault zone. Available data show no evidence of intrusion in the deeper water-bearing zones in this area.

Fluctuations of the chloride content of water from well 6S/10W-6L2 in the Santa Ana Gap during the period 1951 through 1960 are shown on Plate 14.

CHAPTER V.

MISCELLANEOUS ACTIVITIES AFFECTING WATER SUPPLY CONDITIONS

Although not in themselves items of water supply, the formation of water districts and construction activities related to water directly affect water supply conditions in Southern California. For this reason, a brief outline of these important activities which occurred during the 1959-60 season is presented below.

Construction of Dams

Rattlesnake Dam on Rattlesnake Creek, Miramar Dam on Surr Creek, and Box Springs Dam on Box Springs Creek, were completed during the period encompassed by this report. Two other projects, Whale Rock Dam and Lake Mathews enlargement, were in construction and approximately 95 percent and 75 percent complete, respectively, on September 30, 1960. Table 24 lists the various dam projects with reservoir storage capacities in excess of 100 acre-feet which were under construction during the 1959-60 water year. Approximate start and completion dates and the agencies responsible for the work are also shown.

Major Aqueduct Construction

During 1959-60, The Metropolitan Water District of Southern California continued work on several of its projects. Construction to enlarge the main aqueduct to full capacity was completed with the installation of Pumping Unit 9 at each of the four pumping plants and the completion of the second barrel of the aqueduct west of the San Jacinto Tunnel.

TABLE 24

DAM PROJECTS* COMPLETED OR UNDER CONSTRUCTION
DURING THE WATER YEAR 1959-60

Dam Project	Construction period		Agency responsible for construction	Purpose	Location	Reservoir capacity, in acre-feet
	Started	Completed				
Rattlesnake	8-59	12-59	Irvine Co.	Regulating Storage	Rattlesnake Creek Orange County	1,500
Box Springs	9-59	3-60	Riverside County Flood Control and Water Conservation District	Conservation, Flood control	Box Springs Creek Riverside County	387
Miramar	10-59	9-60	City of San Diego	Storage San Diego Aqueduct	Surr Creek San Diego County	7,250
Lake Mathews (enlargement)	3-59	Incomplete	The Metropolitan Water District of Southern California	Terminal reservoir Colorado River Aqueduct	Cajalco Creek Riverside County	180,000
Whale Rock	3-59	Incomplete	State of California and City of San Luis Obispo	Conservation	Old Creek San Luis Obispo County	40,000

* Greater than 100 acre-feet capacity

The San Diego County Water Authority and The Metropolitan Water District of Southern California joined in the construction of the second San Diego Aqueduct. On April 30, 1960 The Metropolitan Water District completed the construction of its portion of the aqueduct to a point six miles south of the Riverside-San Diego County line. The remainder of the aqueduct is being constructed by the San Diego County Water Authority which has completed construction on the first three sections totaling 45.9 miles. The last section, totaling 13.4 miles, was scheduled for completion by January 1, 1961. The completion of the second San Diego Aqueduct will provide the San Diego County Water Authority with the capacity to import water at a rate of about 450 cubic feet per second.

The Metropolitan Water District also continued work on portions of its main distribution system. Construction continued on the West Coast Feeder, which is scheduled to be completed early in 1961, and construction was started on the 4.5-mile East Orange County Feeder to supply water to the Orange County Water District's Crill spreading grounds.

The second expansion of the F. E. Weymouth Softening and Filtration Plant at La Verne was started. When completed in 1962 this expansion will increase the capacity of the plant to 400 million gallons per day.

Water District Formation Activities

During the 1959-60 fiscal year, there were 18 new water agencies formed in the Southern California area. Purposes for which these agencies were formed included the replenishment of ground water basins, the provision of a contractual basis for the purchase of imported water, and the delivery of water. The agencies created are listed according to the type of district, as follows:

Special Districts

Antelope Valley-East Kern Water Agency	Los Angeles and Kern Counties
Mojave Water Agency	San Bernardino County

Water Replenishment District

Central and West Basin Water Replenishment District	Los Angeles County

Municipal Water Districts

Alpine Heights Municipal Water District	San Diego County
Colonia Municipal Water District	Ventura County
Dehesa Valley Municipal Water District	San Diego County
Del Norte Municipal Water District	Ventura County
Hidden Valley Municipal Water District	Ventura County
Huntington Municipal Water District	Los Angeles County
Ocean View Municipal Water District	Ventura County
Russell Valley Municipal Water District	Ventura County
San Gabriel Valley Municipal Water District	Los Angeles County
Upper San Gabriel Valley Municipal Water District	Los Angeles County

County Water Districts

Cambria County Water District	San Luis Obispo County
Costa Mesa County Water District	Orange County
Oxnard Beach County Water District	Ventura County
Waterworks District #29 (Malibu Topanga area)	Los Angeles County

In addition to the foregoing, the service area of The Metropolitan Water District of Southern California continued to increase with the annexation of agencies to the District or annexation of areas to one of its member cities, districts, or authorities. In the 1959-60 fiscal year,

there were ten annexations to the San Diego County Water Authority, one to the Orange County Municipal Water District, and nine to constituent cities of The Metropolitan Water District or the San Diego County Water Authority. A total of 67.12 square miles was added to The Metropolitan Water District by annexations during the 1959-60 fiscal year.

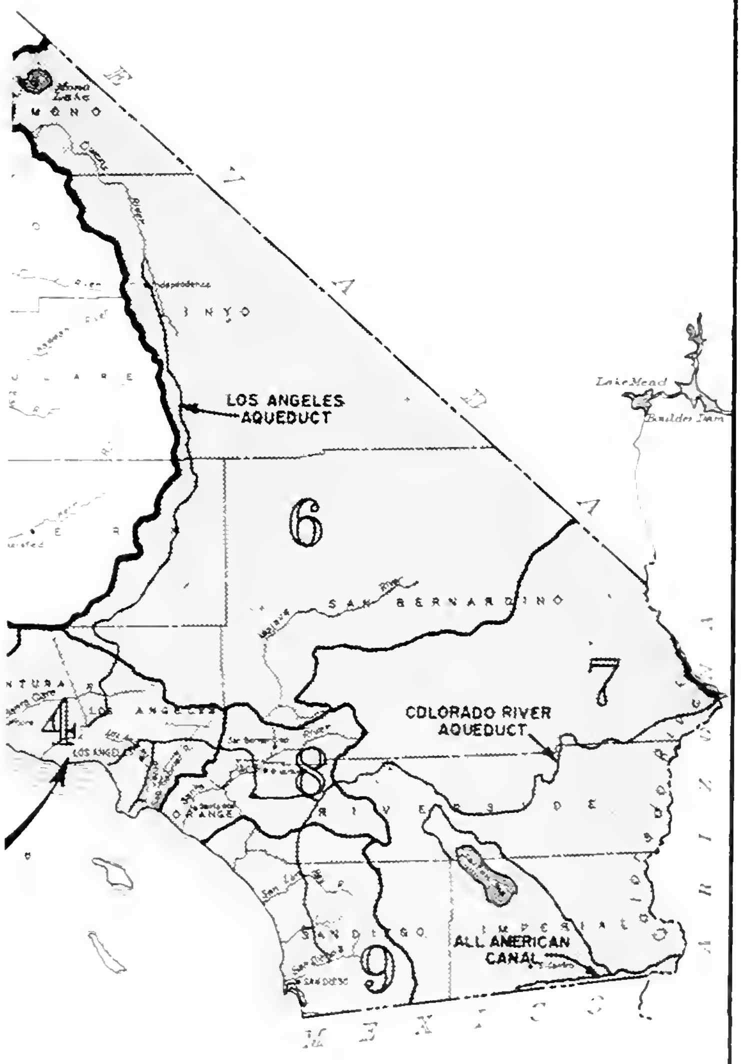
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959 - 60

LOCATION OF SOUTHERN DISTRICT

SCALE OF MILES
40 0 40 80

1961



REGIONS

1 NORTH COASTAL

2 SAN FRANCISCO

3 CENTRAL COASTAL

4 LOS ANGELES

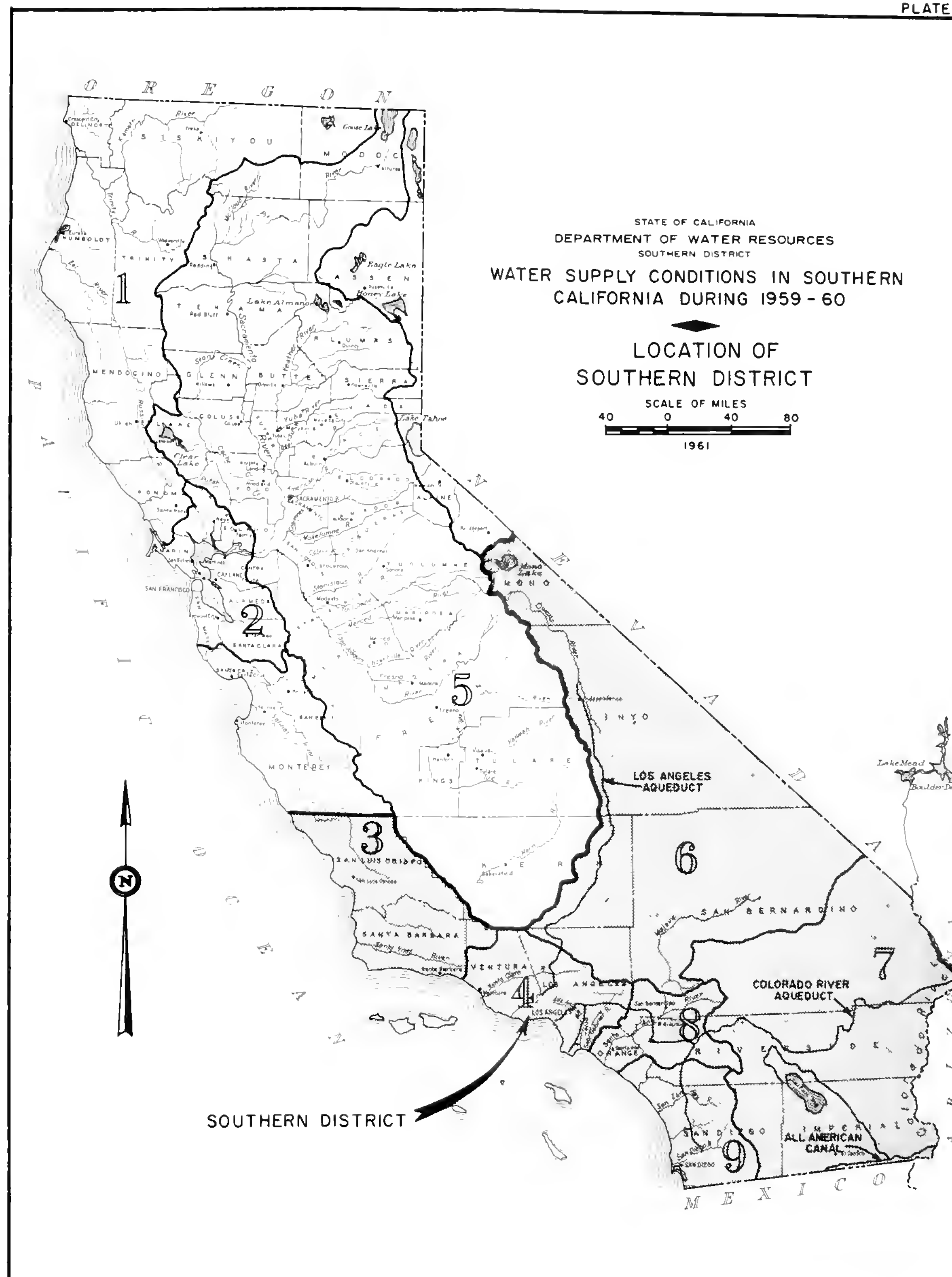
5 CENTRAL VALLEY

6 LAHONTAN

7 COLORADO RIVER BASIN

8 SANTA ANA

9 SAN DIEGO



LEGEND

MEAN SEASONAL PRECIPITATION FOR 50 YEAR PERIOD 1897-1947

LESS THAN 10 INCHES

10 TO 20 INCHES

20 TO 30 INCHES

MORE THAN 30 INCHES

50 YEAR MEAN ISOHYETAL LINES

SOUTHERN CALIFORNIA DISTRICT BOUNDARY

80 PRECIPITATION DURING 1959-60 IN PER CENT OF 50 YEAR MEAN PRECIPITATION

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

PRECIPITATION DURING 1959-60 IN PER CENT OF 50-YEAR MEAN PRECIPITATION

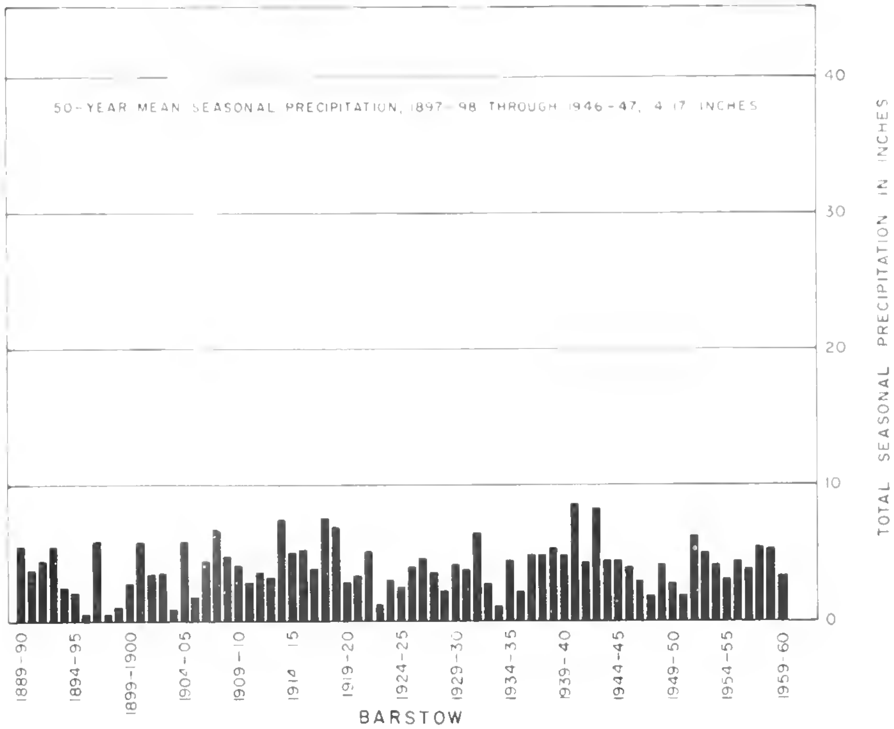
SCALE OF MILES

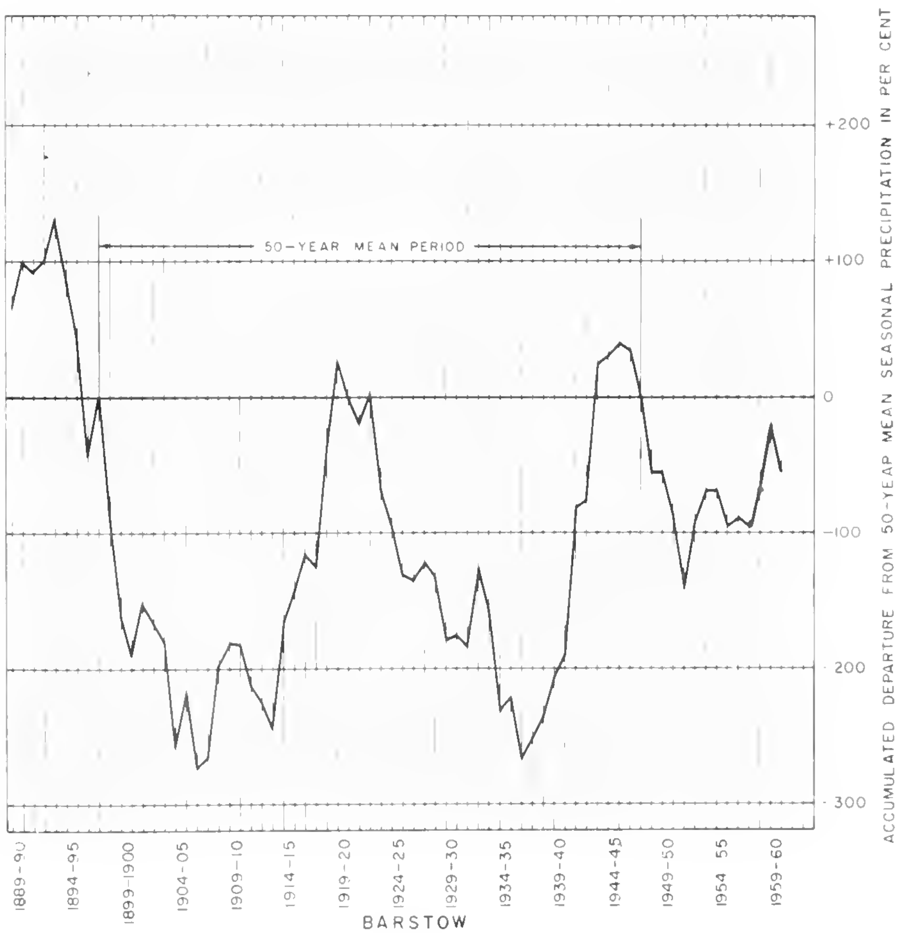
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

PRECIPITATION DURING 1959-60 IN PER CENT OF 50-YEAR MEAN PRECIPITATION

SCALE OF MILES

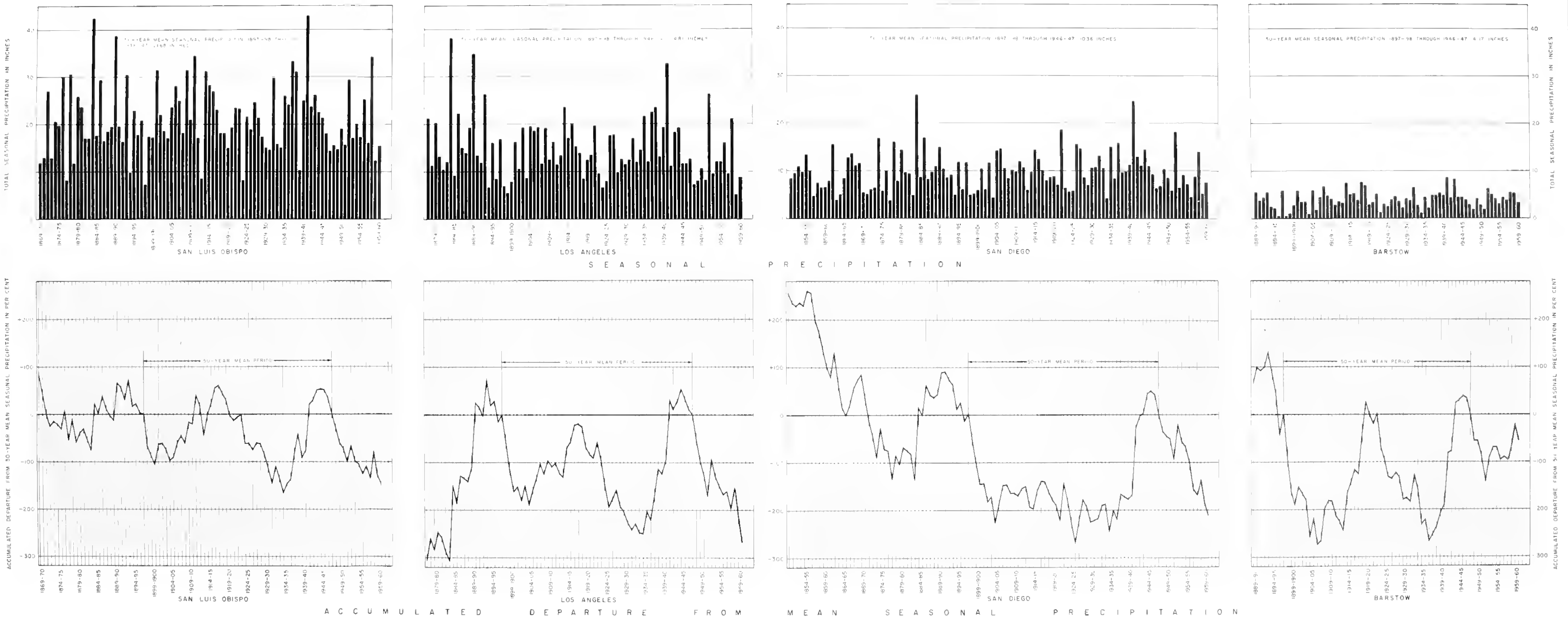
1961



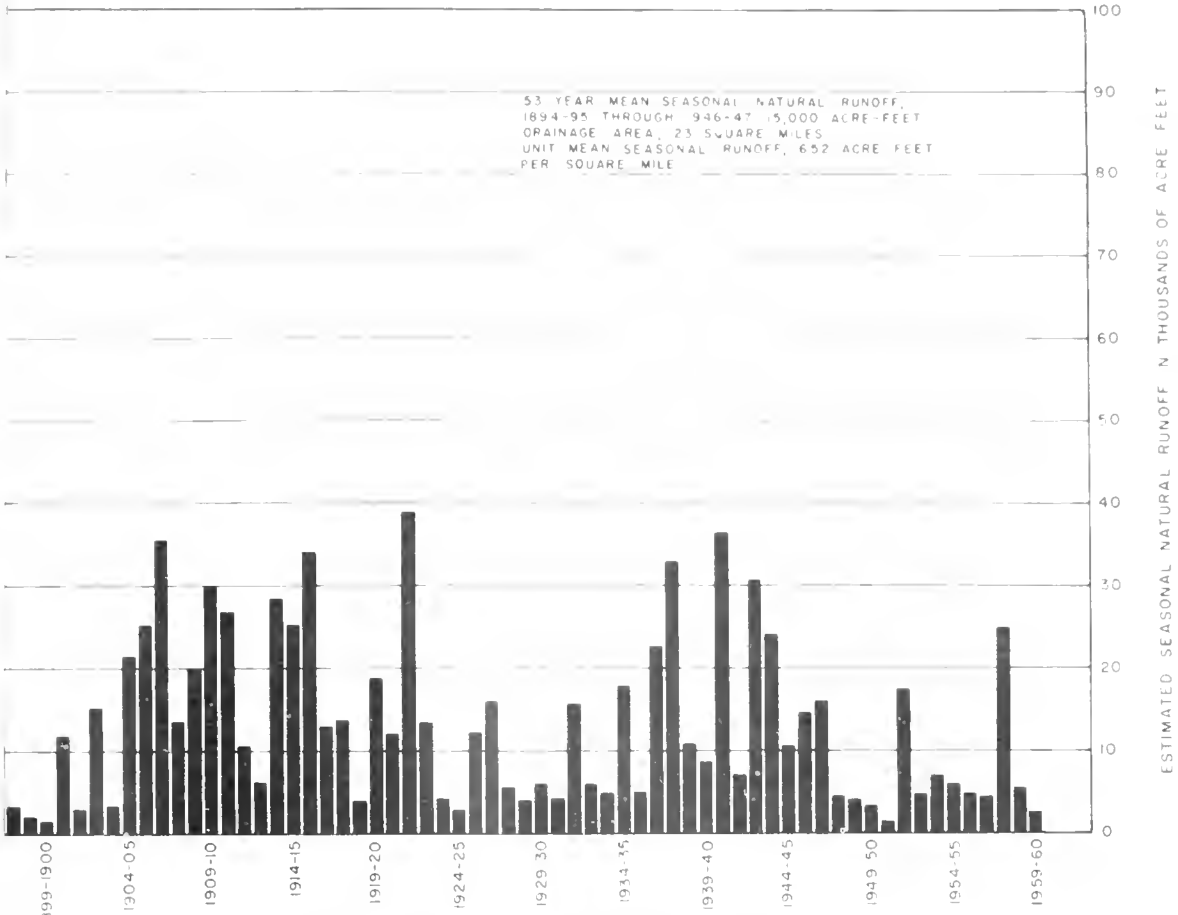


I O N

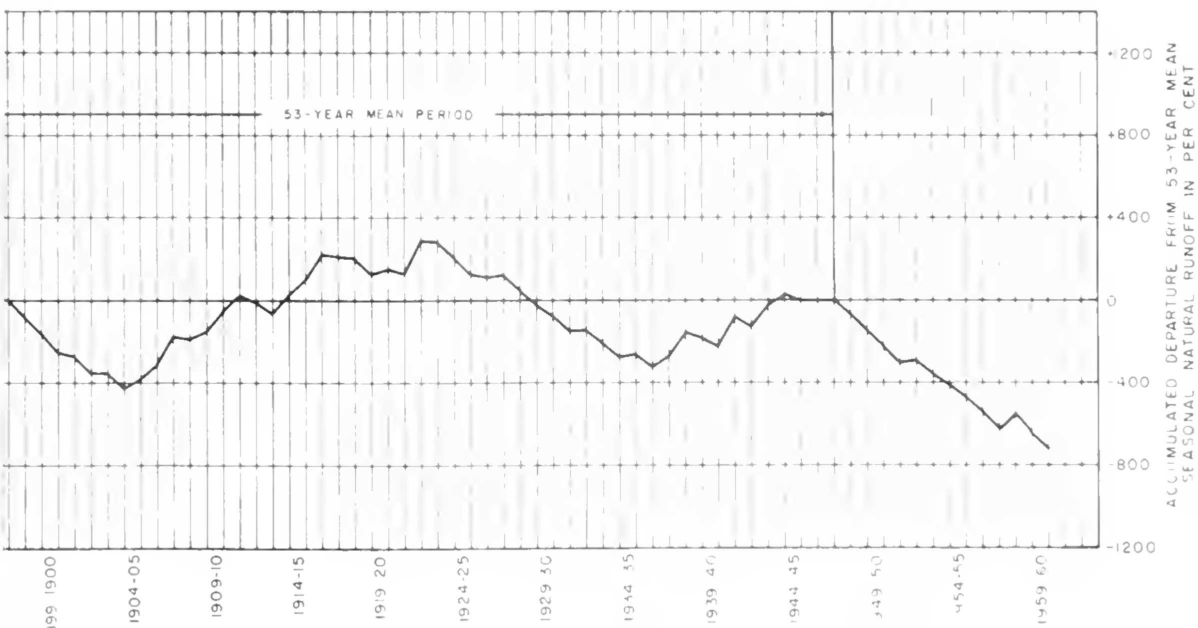
R N C A L I F O R N I A



REPRESENTATIVE PRECIPITATION CHARACTERISTICS IN SOUTHERN CALIFORNIA



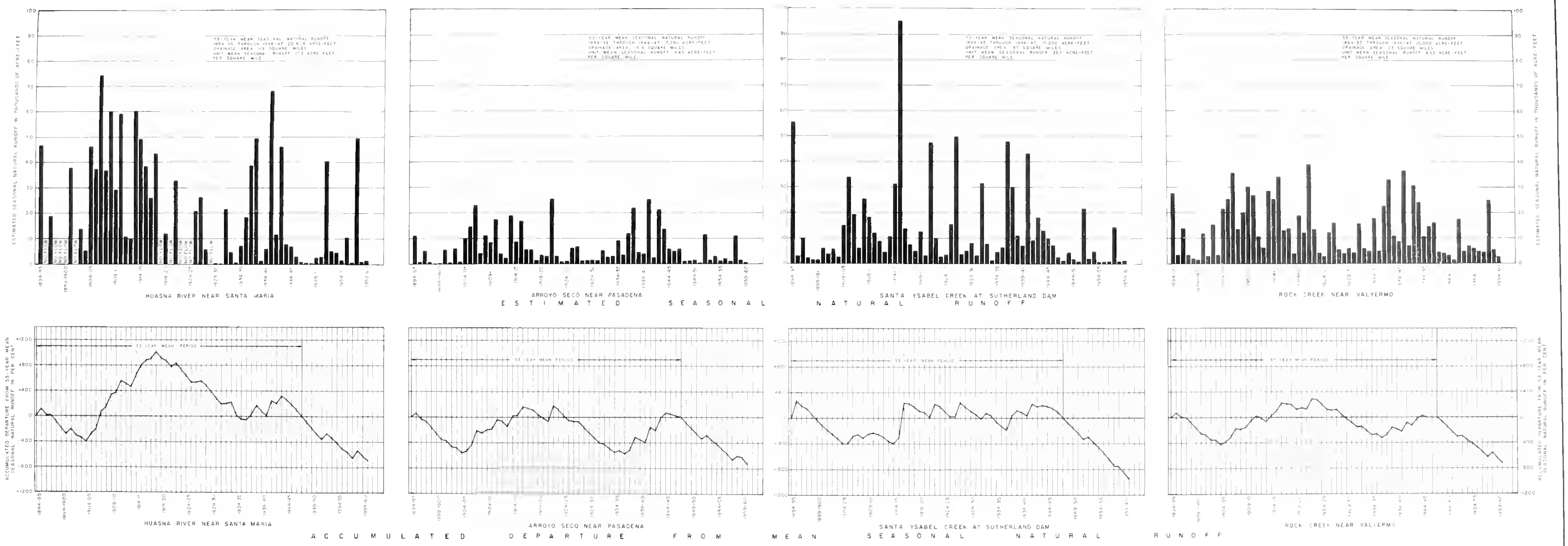
ROCK CREEK NEAR VALYERMO



ROCK CREEK NEAR VALYERMO

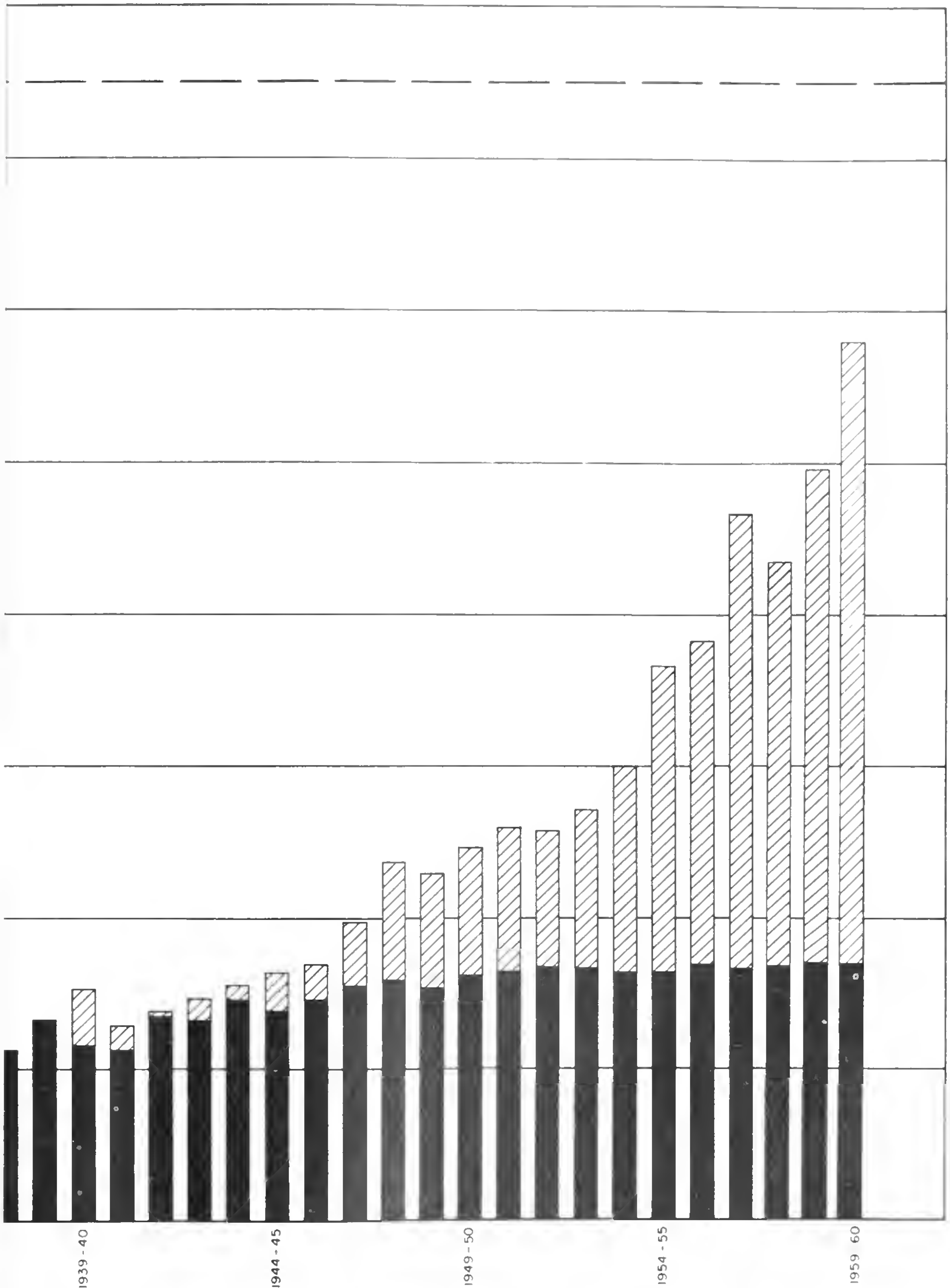
O F F

A L I F O R N I A



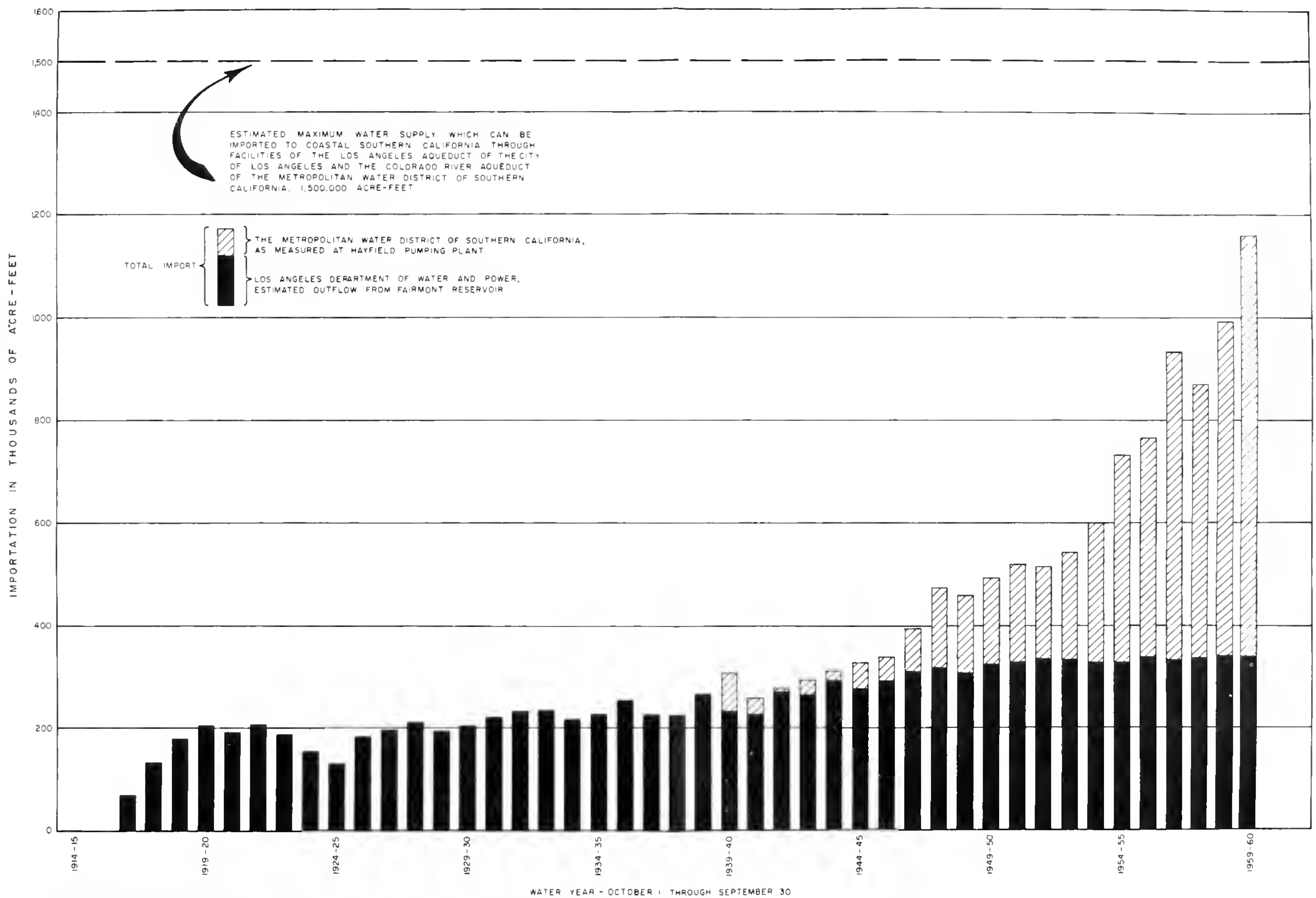
REPRESENTATIVE RUNOFF CHARACTERISTICS IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1961



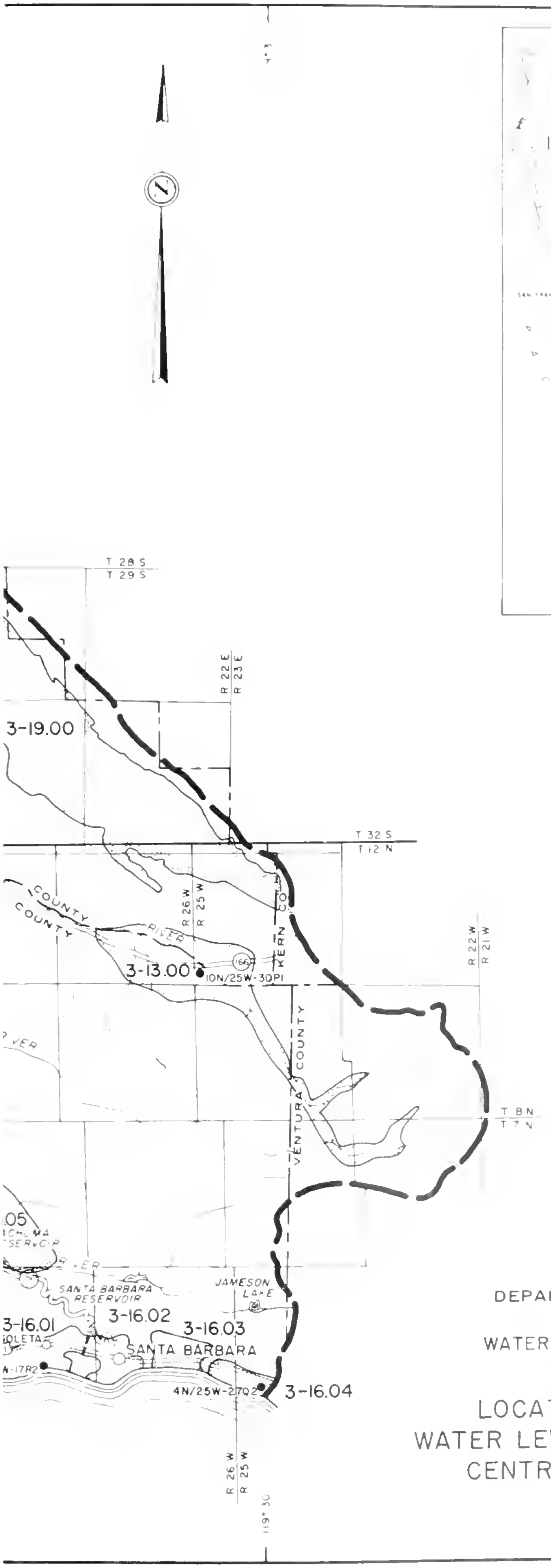
HROUGH SEPTEMBER 30

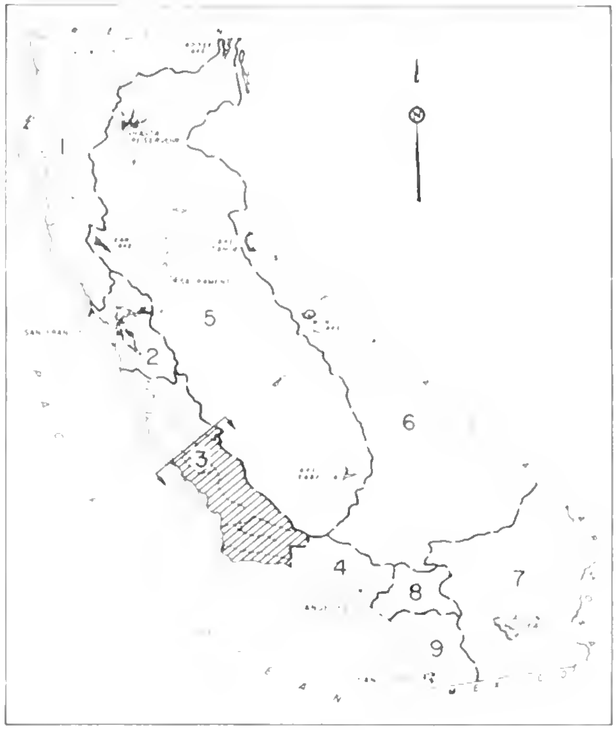
F WATER TO COASTAL
LIFORNIA



HISTORICAL IMPORTATIONS OF WATER TO COASTAL SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1961





KEY MAP

LEGEND

3-3.00 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● 1N/1W-1A1 WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

S.B.B.& M. SAN BERNARDINO BASE AND MERIDIAN

M.D.B.& M. MT. DIABLO BASE AND MERIDIAN

35° 00

34°

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN CENTRAL COASTAL REGION (NO. 3)

SCALE OF MILES
10 0 10

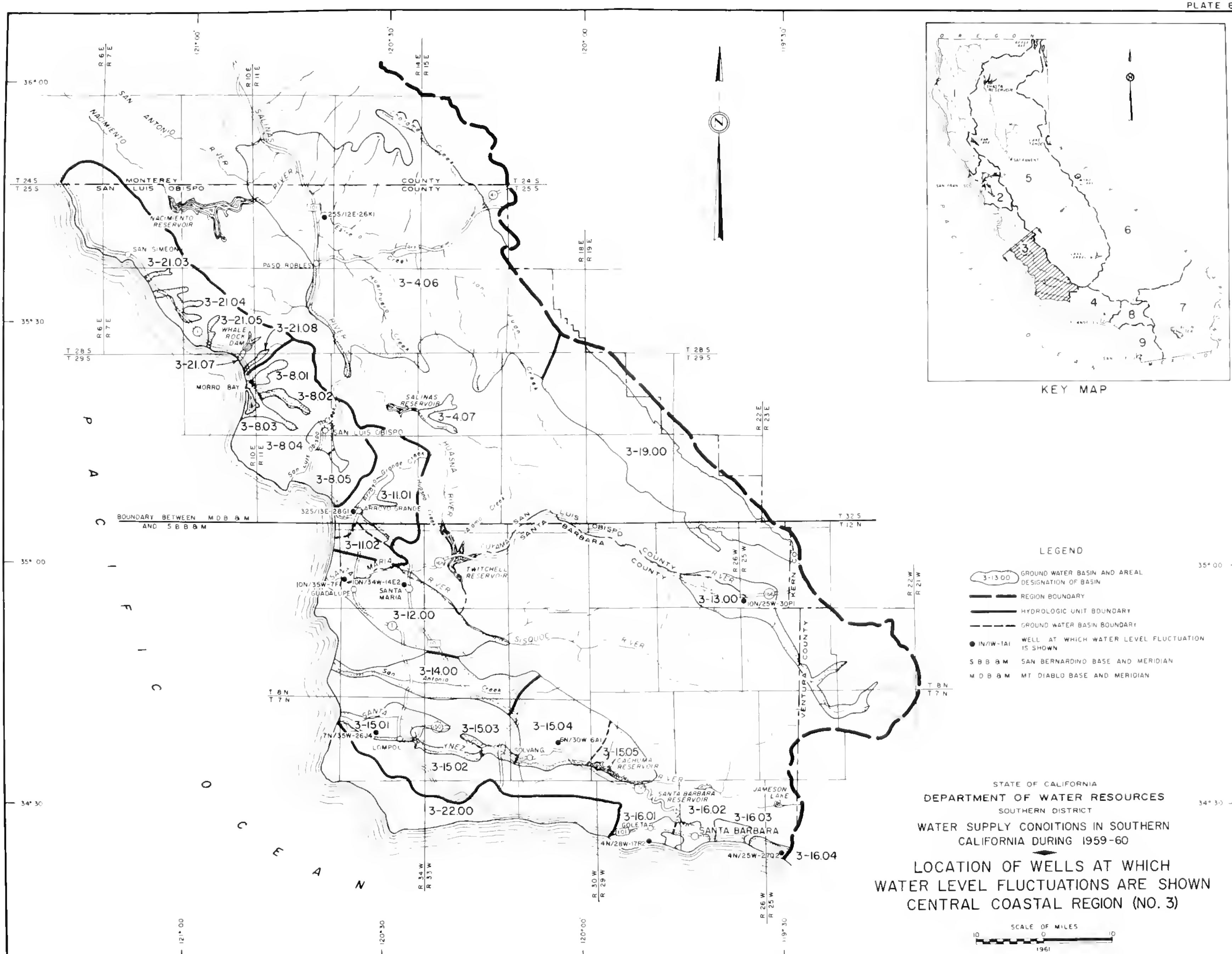
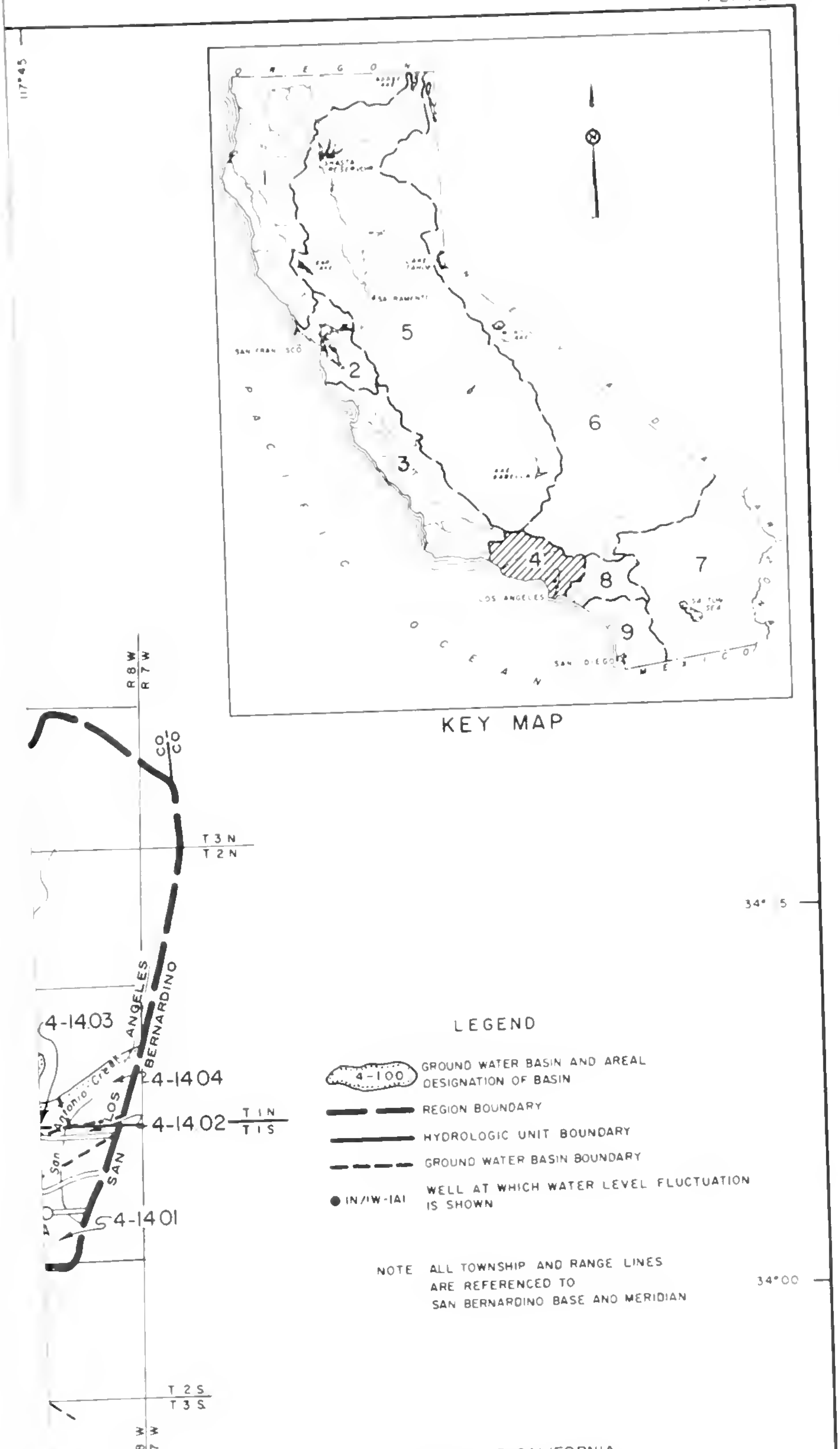

KEY MAP
LEGEND
GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
REGION BOUNDARY
HYDROLOGIC UNIT BOUNDARY
GROUND WATER BASIN BOUNDARY
WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN
S B B & M SAN BERNARDINO BASE AND MERIDIAN
M D B & M MT DIABLO BASE AND MERIDIAN
BOUNDARY BETWEEN M D B & M AND S B B & M
PACIFIC OCEAN
MONTEREY COUNTY
SAN LUIS OBISPO COUNTY
SANTA BARBARA COUNTY
KERN CO
VENTURA COUNTY
NACIMIENTO RESERVOIR
SAN SIMEON
PASO ROBLES
MORRO BAY
WHALE ROCK DAM
SALINAS RESERVOIR
SAN LUIS OBISPO
ARROYO GRANDE
TWITCHELL RESERVOIR
GUADALUPE
SANTA MARIA
LOMPOC
SOLVANG
CACHUMA RESERVOIR
SANTA BARBARA RESERVOIR
JAMESON LAKE
GOLETA
SANTA BARBARA
3-21.03
3-21.04
3-21.05
3-21.07
3-21.08
3-4.06
3-4.07
3-8.01
3-8.02
3-8.03
3-8.04
3-8.05
3-11.01
3-11.02
3-12.00
3-13.00
3-14.00
3-15.01
3-15.02
3-15.03
3-15.04
3-15.05
3-16.01
3-16.02
3-16.03
3-16.04
3-19.00
3-22.00
25S/12E-26K1
32S/13E-28G1
10N/35W-7F1
10N/34W-14E2
10N/25W-30P1
7N/35W-26J4
6N/30W-6A1
4N/28W-17R2
4N/25W-27Q2
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN
CENTRAL COASTAL REGION (NO. 3)
SCALE OF MILES
1961

PLATE 7



STATE OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

SOUTHERN DISTRICT

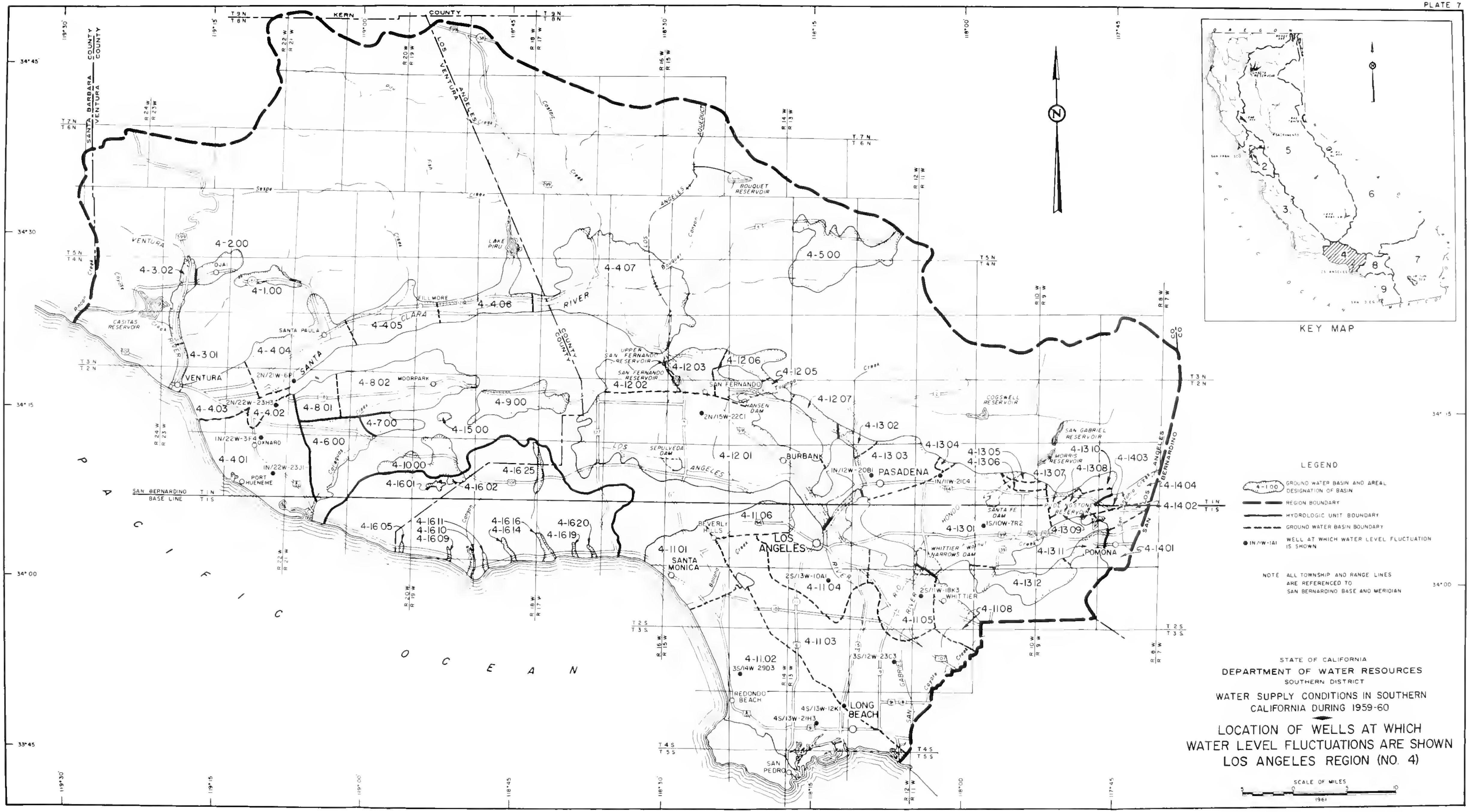
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

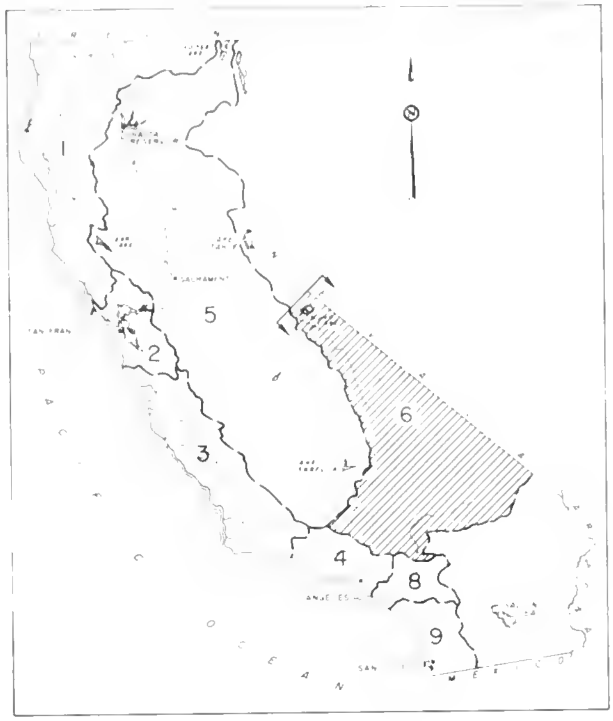
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN LOS ANGELES REGION (NO. 4)

SCALE OF MILES

5 0 5 10

1961


KEY MAP
LEGEND
GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
REGION BOUNDARY
HYDROLOGIC UNIT BOUNDARY
GROUND WATER BASIN BOUNDARY
WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN
NOTE ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN
PACIFIC OCEAN
SAN BERNARDINO BASE LINE
KERN COUNTY
LOS ANGELES COUNTY
VENTURA COUNTY
SANTA BARBARA COUNTY
VENTURA
OJAI
FILLMORE
SANTA PAULA
MOORPARK
OXNARD
PORT HUENEME
SAN FERNANDO
BURBANK
PASADENA
LOS ANGELES
BEVERLY HILLS
SANTA MONICA
WHITTIER
POMONA
REDONDO BEACH
LONG BEACH
SAN PEDRO
SCALE OF MILES
1961
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN
LOS ANGELES REGION (NO. 4)



KEY MAP

LEGEND

6-900	GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
	REGION BOUNDARY
	HYDROLOGIC UNIT BOUNDARY
	GROUND WATER BASIN BOUNDARY
● IN/IW-IAI	WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN
M D B & M	MT DIABLO BASE AND MERIDIAN
S B B & M	SAN BERNARDINO BASE & MERIDIAN

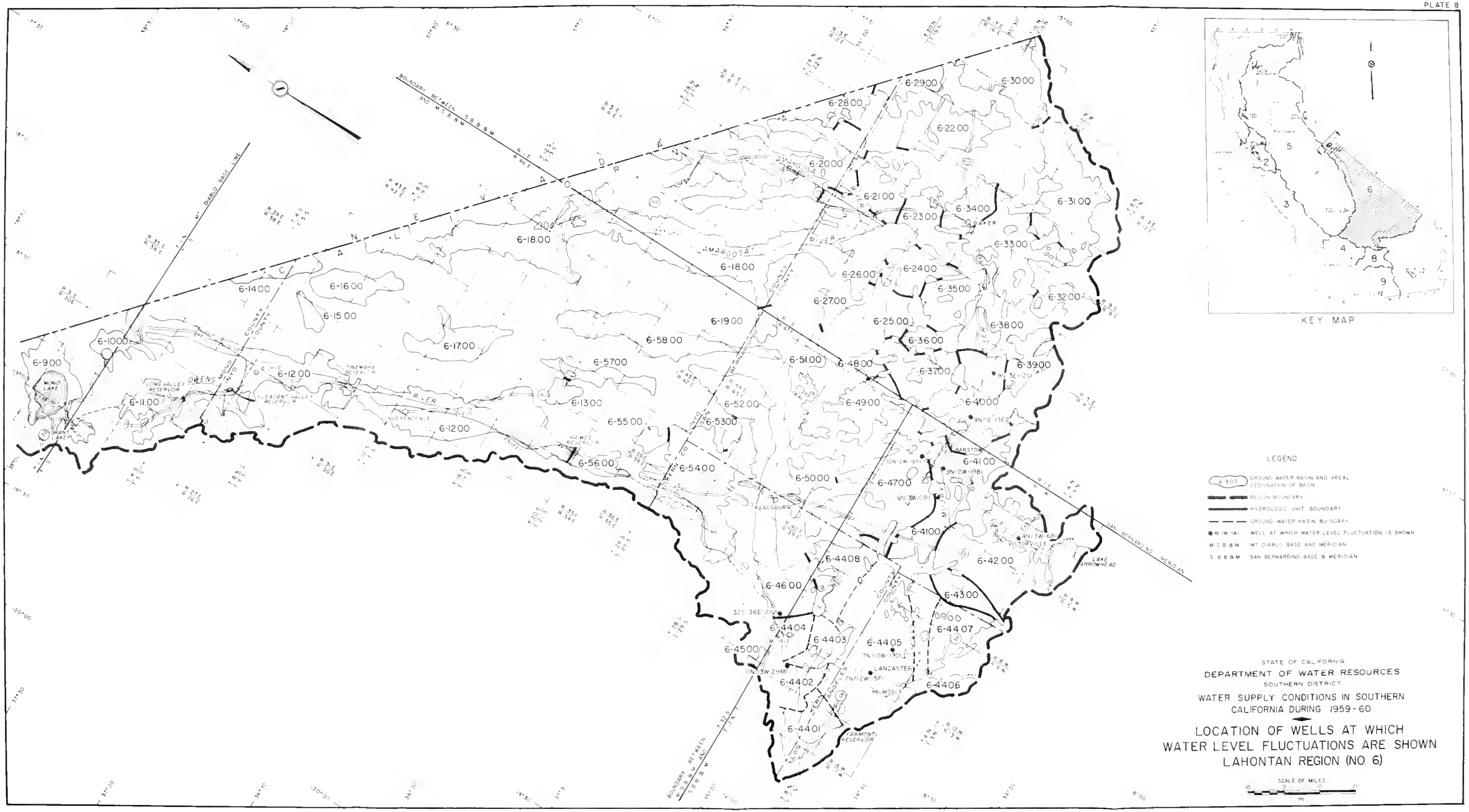
SAN BERNARDINO MERIDIAN

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN LAHONTAN REGION (NO. 6)

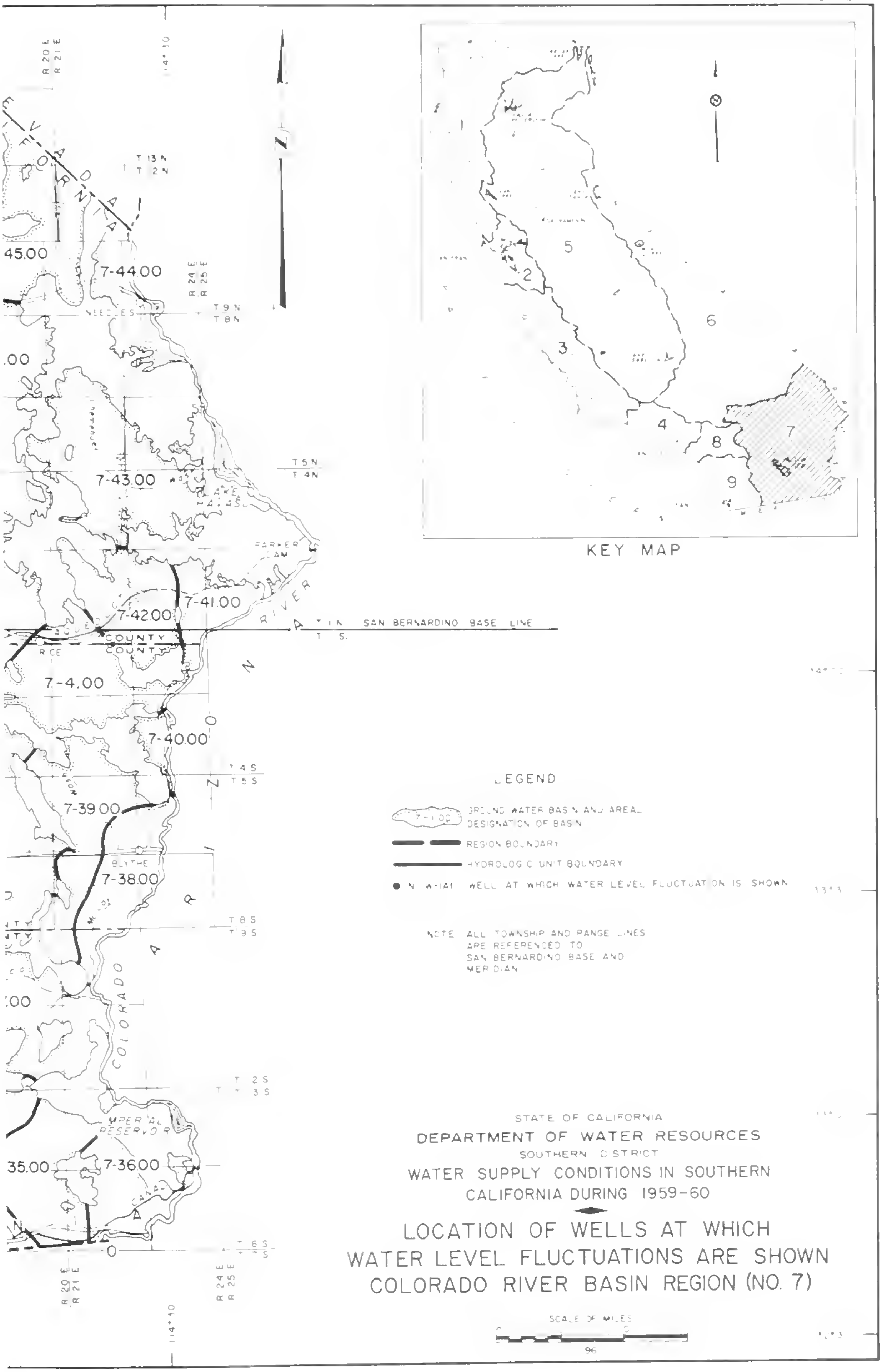
SCALE OF MILES



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

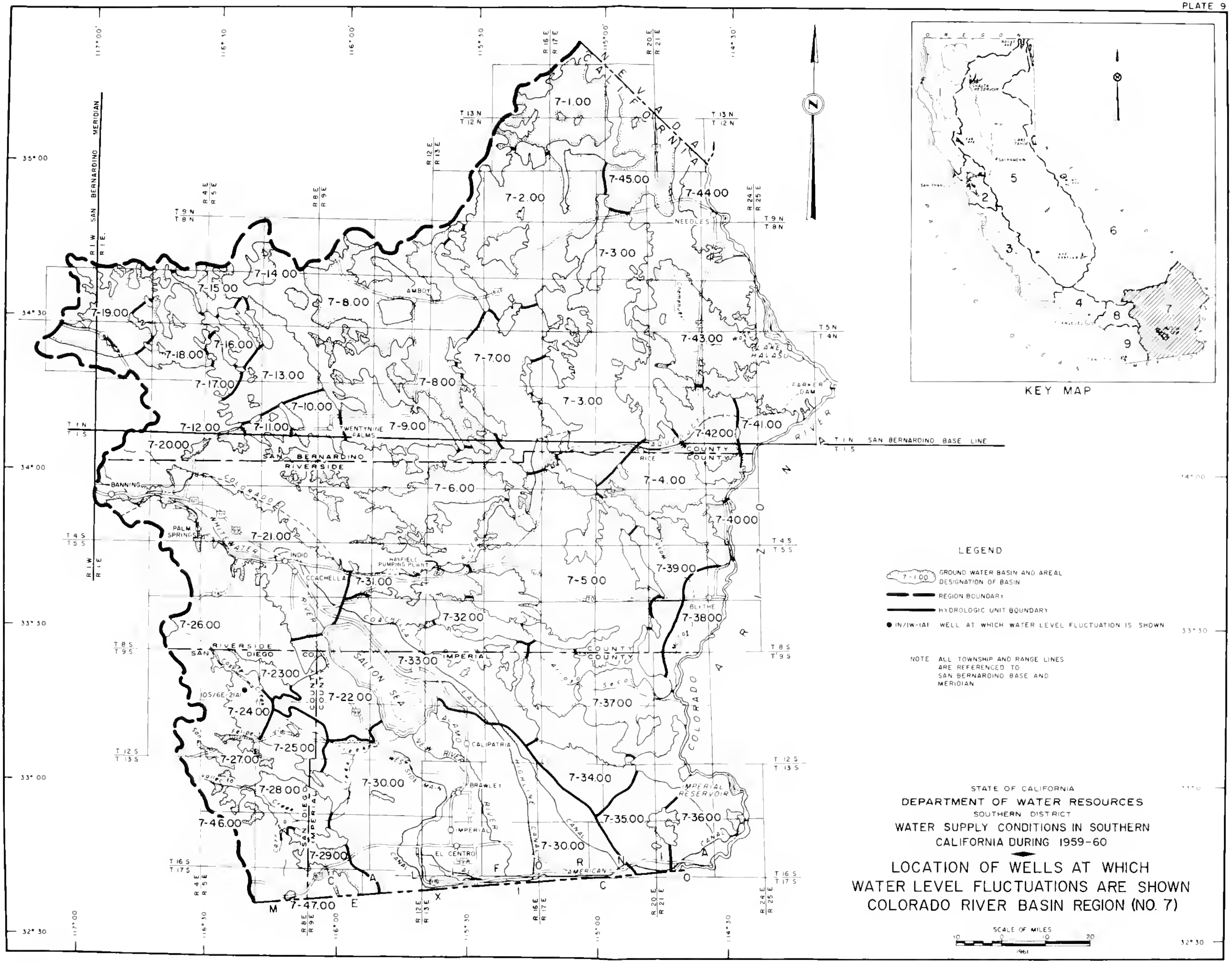
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

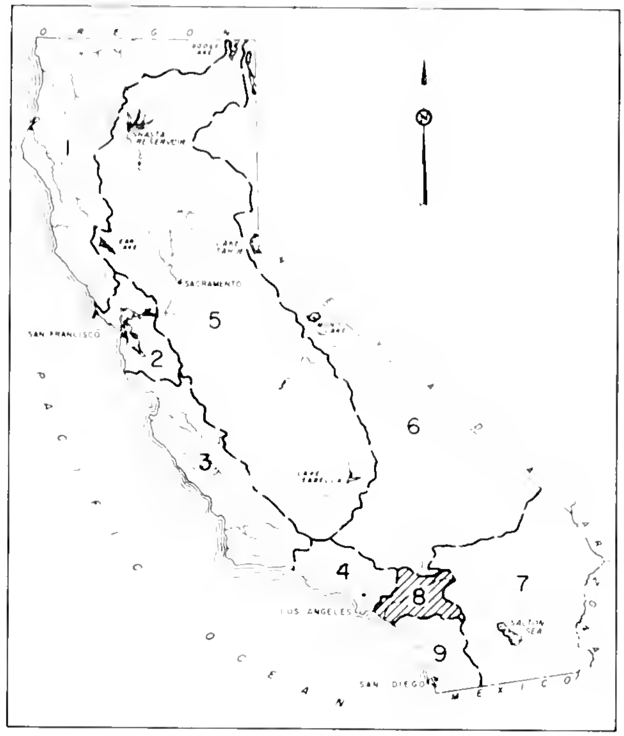
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN
LAHONTAN REGION (NO. 6)



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN COLORADO RIVER BASIN REGION (NO. 7)


KEY MAP
LEGEND
7-1.00 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
REGION BOUNDARY
HYDROLOGIC UNIT BOUNDARY
● IN/IW-IA1 WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN
NOTE ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN COLORADO RIVER BASIN REGION (NO. 7)
SCALE OF MILES
1961
SAN BERNARDINO BASE LINE
SAN BERNARDINO MERIDIAN
NEEDLES
AMBOY
TWENTYNINE PALMS
BANNING
PALM SPRINGS
INDIO
COACHELLA
HAYFIELD PUMPING PLANT
RICE
BLYTHE
CALIPATRIA
BRAWLEY
IMPERIAL
EL CENTRO
LAKE HAVASU
PARKER DAM
IMPERIAL RESERVOIR
SALTON SEA
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
SAN DIEGO COUNTY
IMPERIAL COUNTY
CALIFORNIA
NEVADA
ARIZONA
MEXICO
COLORADO RIVER
10S/6E-21A1
7-1.00
7-2.00
7-3.00
7-4.00
7-5.00
7-6.00
7-7.00
7-8.00
7-9.00
7-10.00
7-11.00
7-12.00
7-13.00
7-14.00
7-15.00
7-16.00
7-17.00
7-18.00
7-19.00
7-20.00
7-21.00
7-22.00
7-23.00
7-24.00
7-25.00
7-26.00
7-27.00
7-28.00
7-29.00
7-30.00
7-31.00
7-32.00
7-33.00
7-34.00
7-35.00
7-36.00
7-37.00
7-38.00
7-39.00
7-40.00
7-41.00
7-42.00
7-43.00
7-44.00
7-45.00
7-46.00
7-47.00



KEY MAP

34° 00'

LEGEND

B-2 12 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● 1N/1W-1A1 WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

33° 45'

NOTE ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

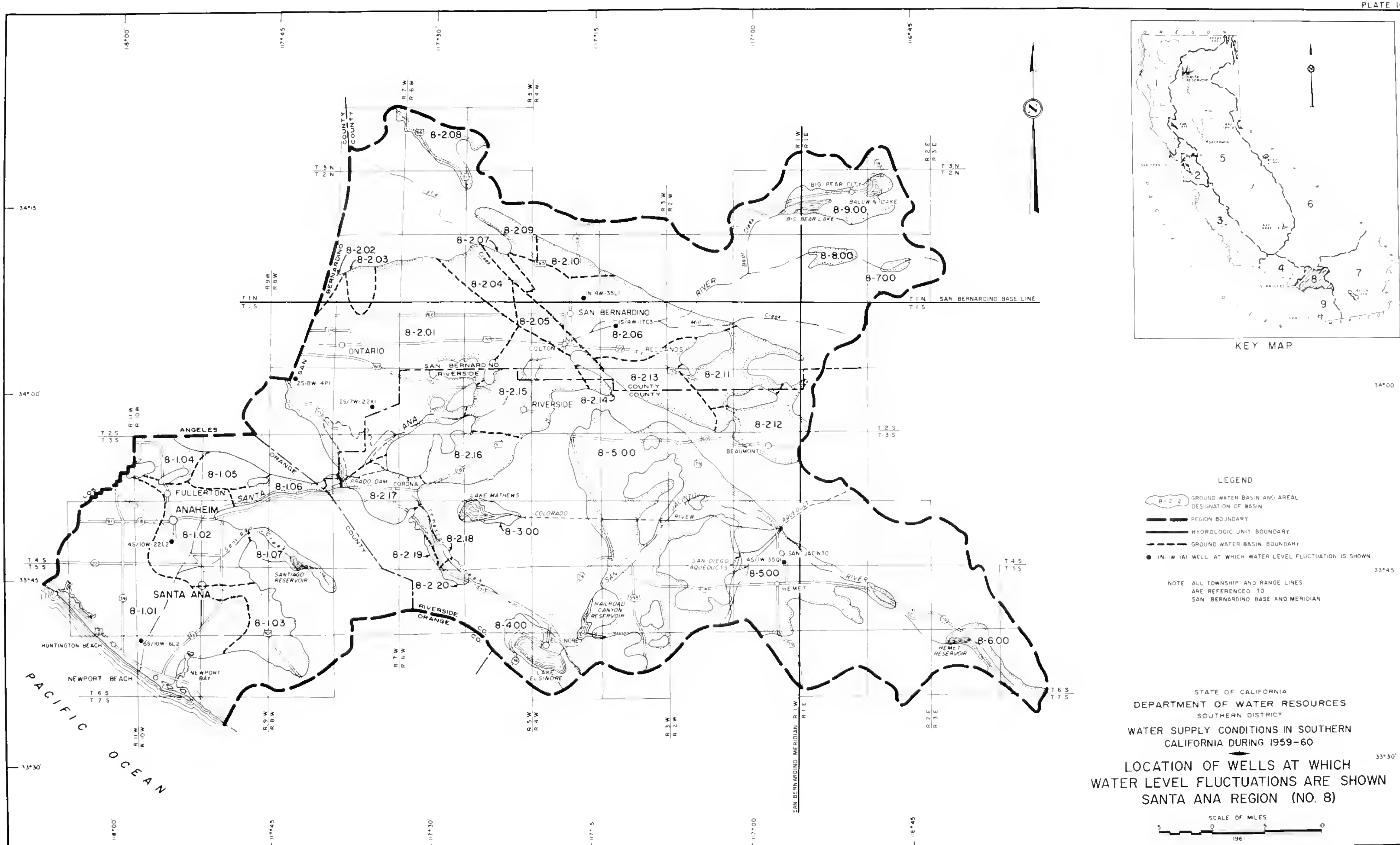
33° 30'

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN SANTA ANA REGION (NO. 8)

SCALE OF MILES

5 0 5 10

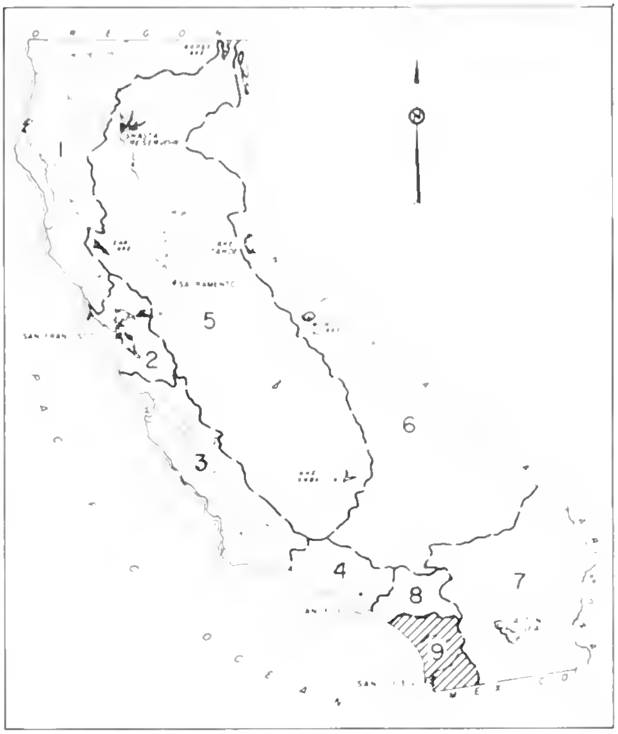
1961



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN SANTA ANA REGION (NO. 8)



KEY MAP

33° 15

LEGEND

9-8.00 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● 1N/1W-1A1 WELL AT WHICH WHICH WATER LEVEL FLUCTUATION IS SHOWN

NOTE: ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

33° 00

32° 45

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

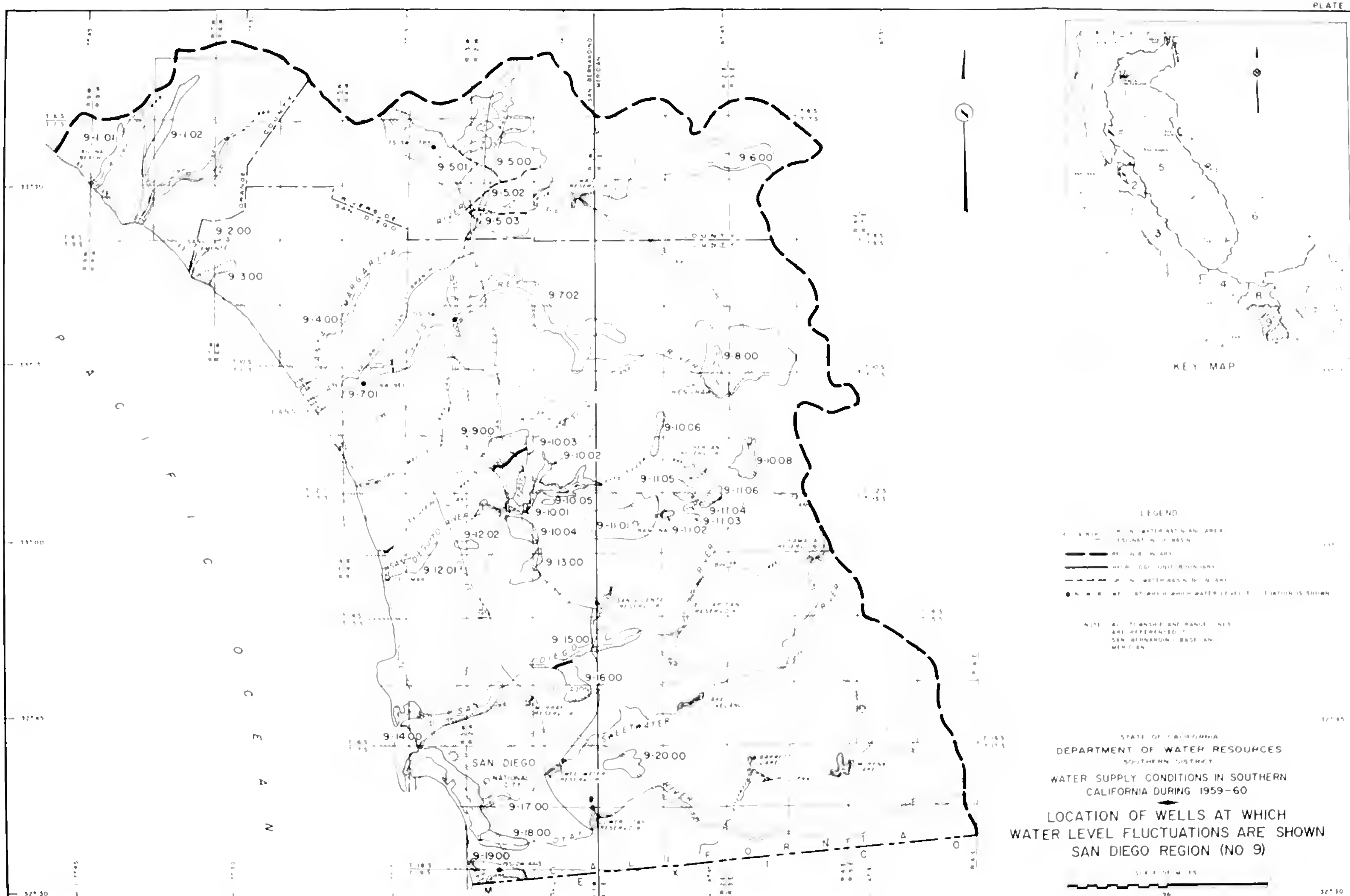
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60

LOCATION OF WELLS AT WHICH
ER LEVEL FLUCTUATIONS ARE SHOWN
SAN DIEGO REGION (NO. 9)

SCALE OF MILES

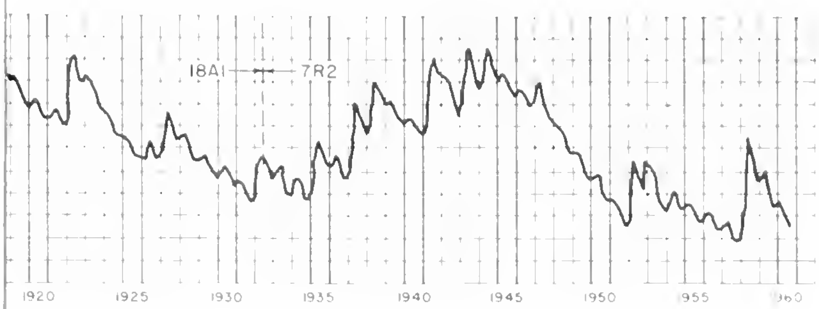
1961

32° 30

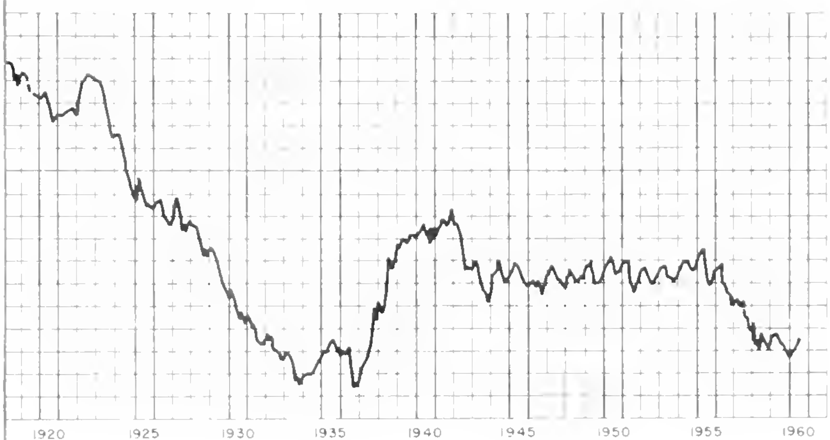


STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN
SAN DIEGO REGION (NO 9)
KEY MAP
LEGEND
PACIFIC OCEAN
MEXICO
CALIFORNIA
SAN DIEGO
NATIONAL CITY
ORANGE COUNTY
SAN BERNARDINO MERIDIAN
COUNTY
SANTA MARGARITA
RIVER
SAN DIEGUITO RIVER
SAN DIEGO
SWEETWATER
9-1.01
9-1.02
9-2.00
9-3.00
9-4.00
9-5.00
9-5.01
9-5.02
9-5.03
9-6.00
9-7.01
9-7.02
9-8.00
9-9.00
9-10.01
9-10.02
9-10.03
9-10.04
9-10.05
9-10.06
9-10.08
9-11.01
9-11.02
9-11.03
9-11.04
9-11.05
9-11.06
9-12.01
9-12.02
9-13.00
9-14.00
9-15.00
9-16.00
9-17.00
9-18.00
9-19.00
9-20.00

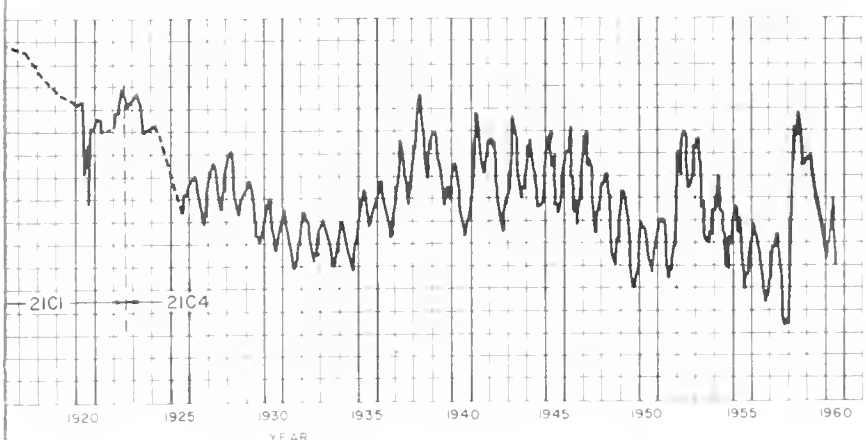
SAN GABRIEL VALLEY (4-13.00)
MAIN SAN GABRIEL BASIN (4-13.01)
WELLS 1S/10W-18A1, 7R2, S.B.B & M



PASADENA SUBAREA (4-13.03)
WELL 1N/12W-20B1, S.B.B & M.

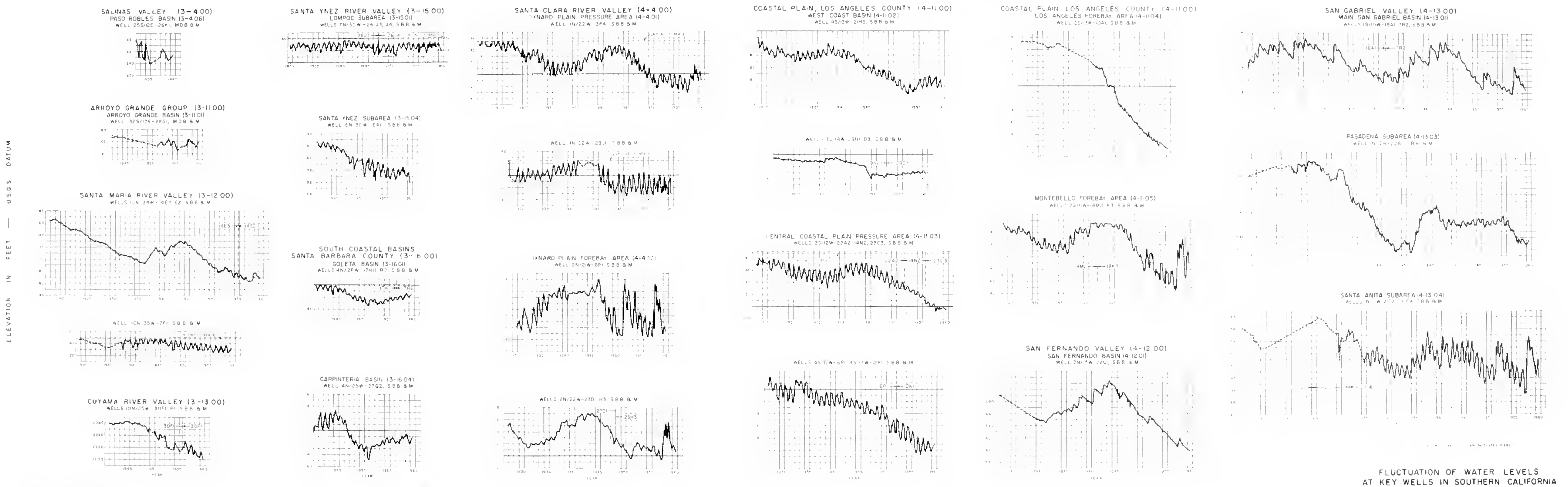


SANTA ANITA SUBAREA (4-13.04)
WELLS 1N/11W-21C2, C1, C4, S.B.B & M.



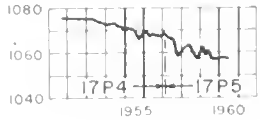
NOTE: LOCATION OF WELLS SHOWN ON PLATES 6 AND 7

FLUCTUATION OF WATER LEVELS AT KEY WELLS IN SOUTHERN CALIFORNIA

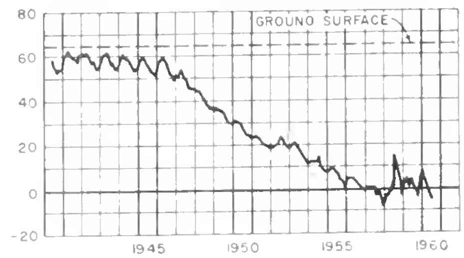


FLUCTUATION OF WATER LEVELS
AT KEY WELLS IN SOUTHERN CALIFORNIA

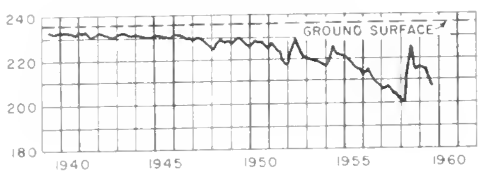
TEMECULA VALLEY (9-5.00)
MURRIETA BASIN (9-5.01)
WELLS 7S/3W-17P4, 17P5, S B B & M



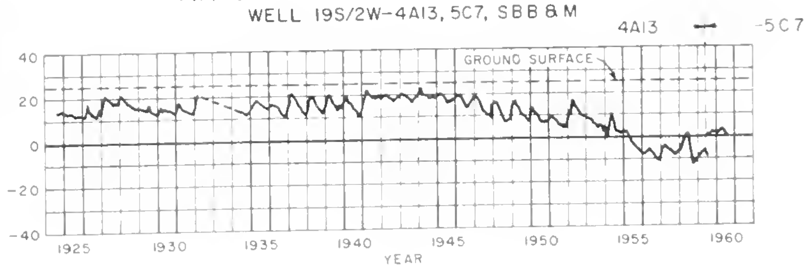
SAN LUIS REY VALLEY (9-7.00)
MISSION BASIN (9-7.01)
WELL 11S/4W-9E1, S.B.B. & M.



BONSALL BASIN (9-7.02)
WELL 10S/3W-11G1, S.B.B. & M.

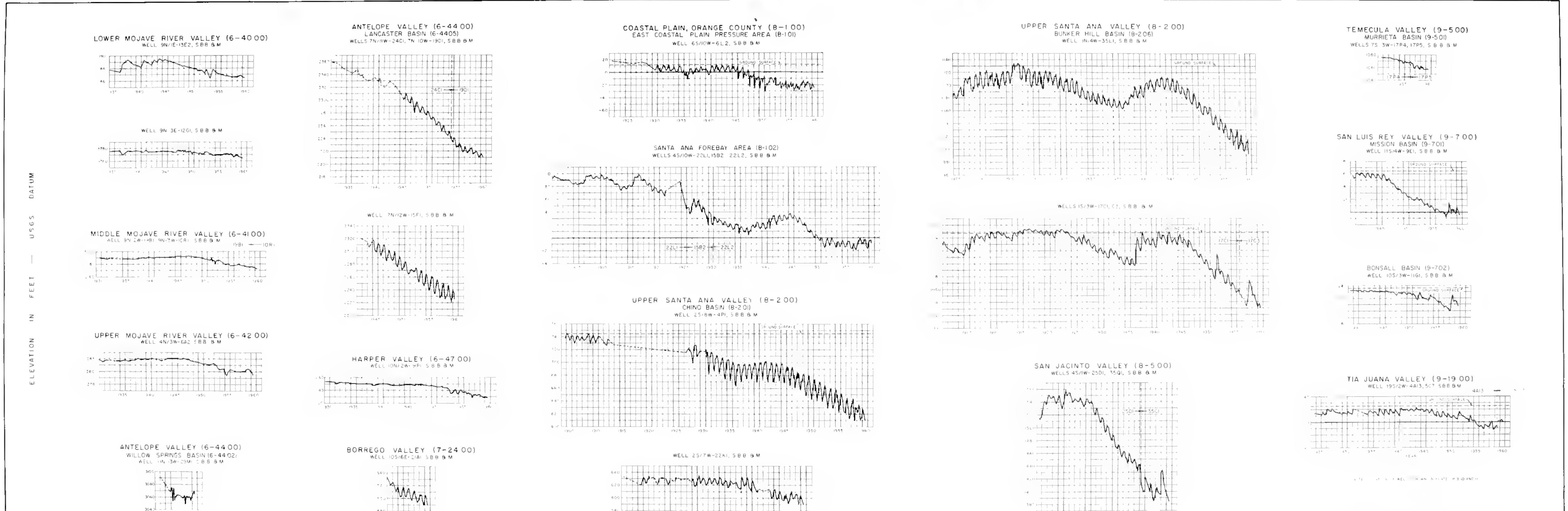


TIA JUANA VALLEY (9-19.00)
WELL 19S/2W-4A13, 5C7, S.B.B.& M.

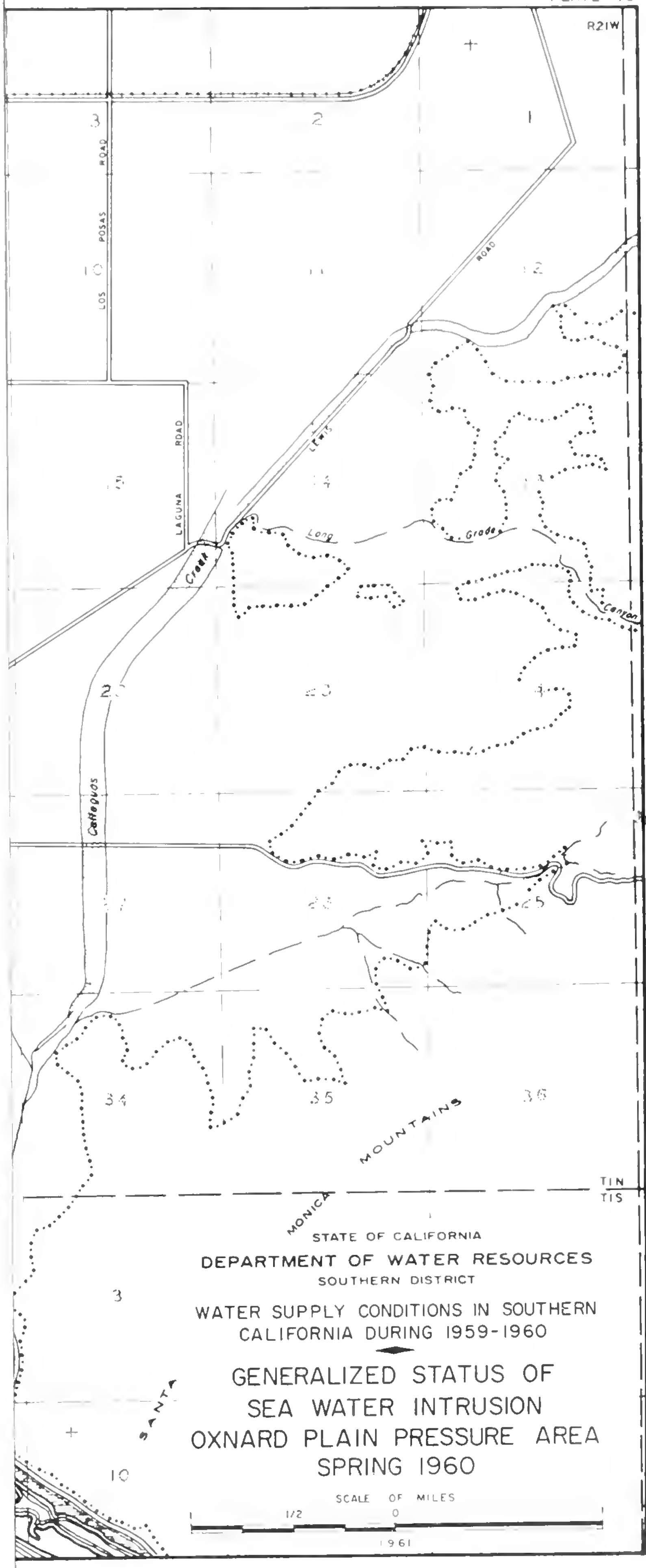


NOTE: LOCATION OF WELLS SHOWN ON PLATES 8,9,10 AND 11

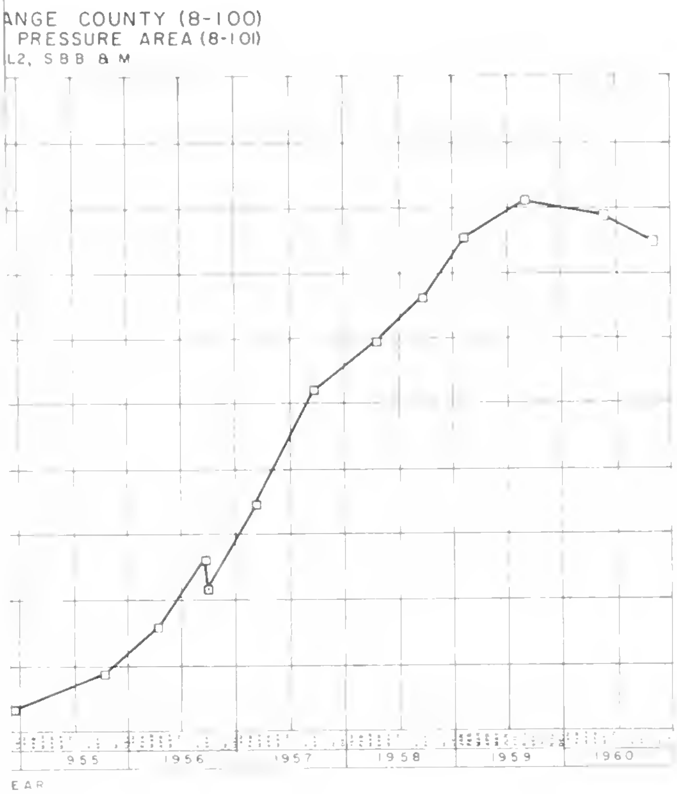
FLUCTUATION OF WATER LEVELS AT KEY WELLS IN SOUTHERN CALIFORNIA

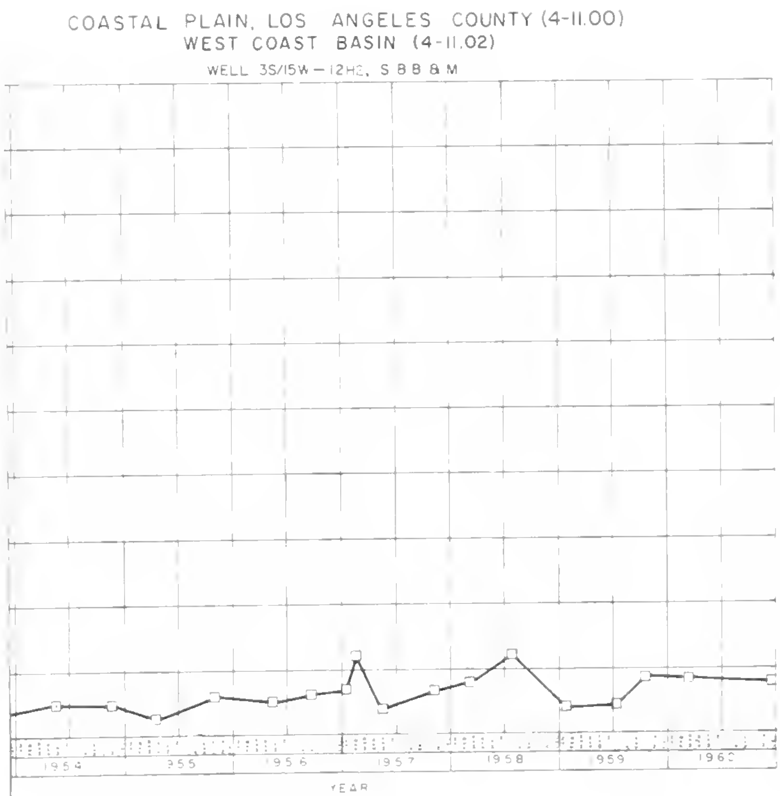


FLUCTUATION OF WATER LEVELS
AT KEY WELLS IN SOUTHERN CALIFORNIA


R21W
LOS POSAS ROAD
LAGUNA ROAD
Lewis ROAD
Long Grade Canyon
Conejo Creek
Calleguas
MOUNTAINS
SANTA MONICA
T1N
T1S
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-1960
GENERALIZED STATUS OF SEA WATER INTRUSION OXNARD PLAIN PRESSURE AREA SPRING 1960
SCALE OF MILES
1/2
0
1961

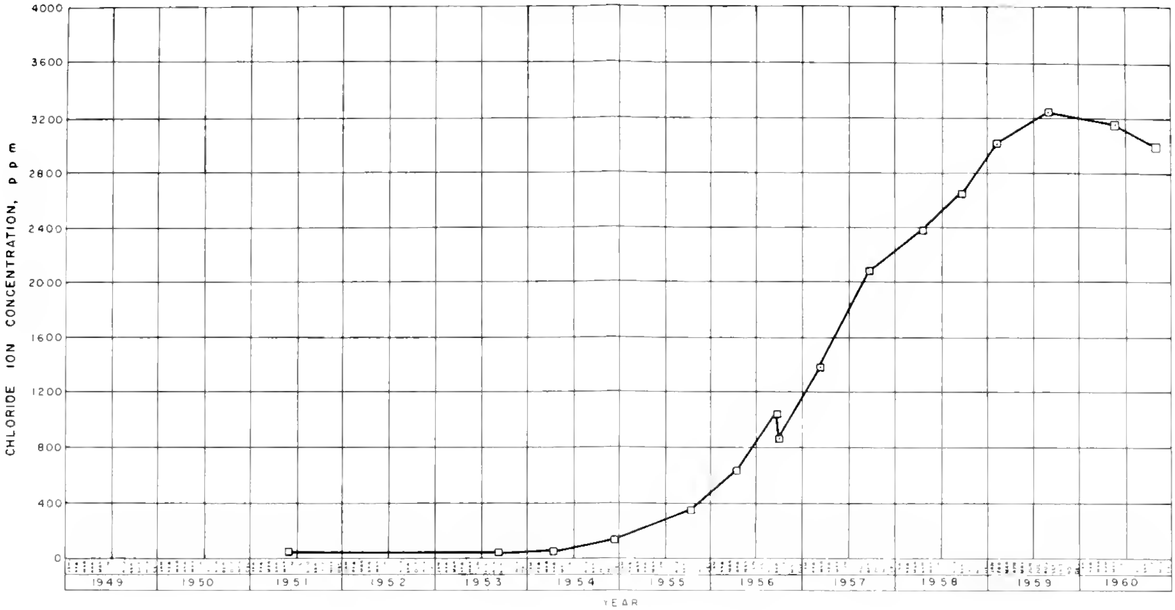
LEGEND
CITY BOUNDARY
NAVAL RESERVATION BOUNDARY
EDGE OF NONWATER-BEARING AREA (HILLS)
WELL USED FOR WATER QUALITY CONTROL WITH 1960 DATA
WELL USED FOR WATER QUALITY CONTROL WITH DATA PRIOR TO 1960 ONLY
WELL USED FOR WATER LEVEL CONTROL
WELL USED FOR BOTH WATER QUALITY AND WATER LEVEL CONTROL
-10 LINE OF EQUAL ELEVATION OF GROUND WATER AT WELLS IN THE OXNARD AQUIFER, JUNE 1960
LINE OF EQUAL CHLORIDE ION CONCENTRATION IN WELLS IN THE OXNARD AQUIFER, SPRING 1960
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING, 1960
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-1960
GENERALIZED STATUS OF SEA WATER INTRUSION OXNARD PLAIN PRESSURE AREA SPRING 1960
SCALE OF MILES
1/2 0 1
1961
PACIFIC OCEAN
OXNARD
PORT HUENEME
NAVAL RESERVATION
POINT MUGU NAVAL RESERVATION
MUGU LAGOON
SANTA MONICA MOUNTAINS
R23W R22W
R22W R21W
R21W
T1N T1S



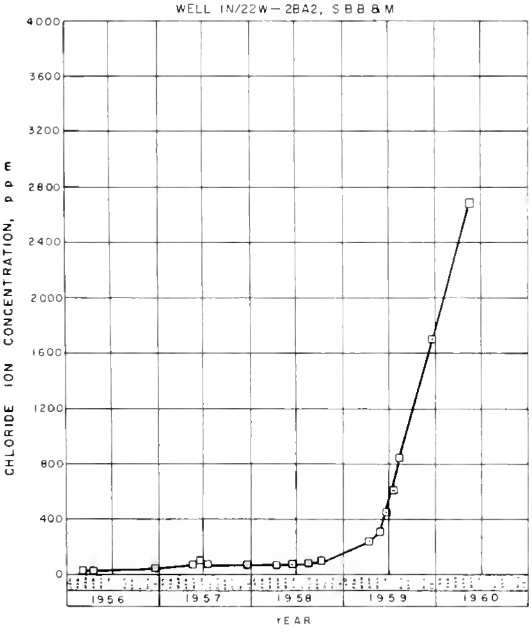


ONCENTRATION IN SELECTED WELLS

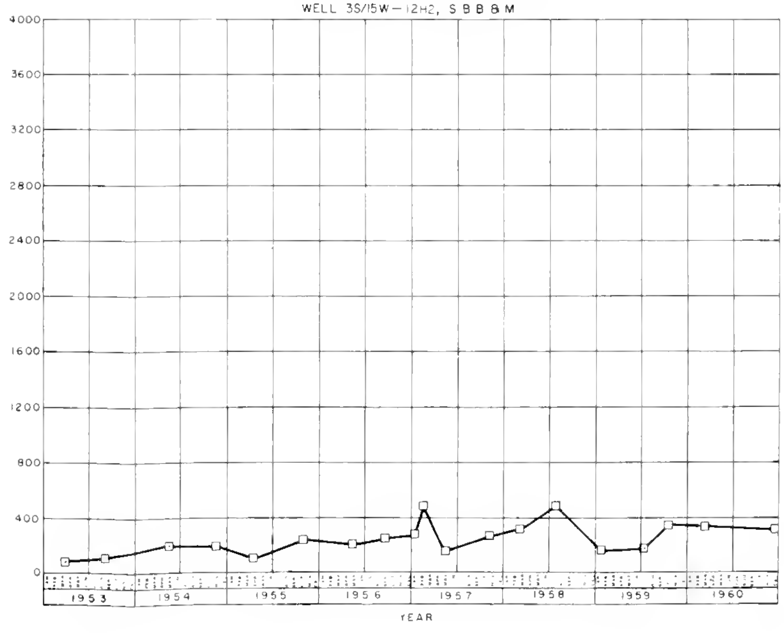
COASTAL PLAIN, ORANGE COUNTY (8-100)
EAST COASTAL PLAIN PRESSURE AREA (8-101)
WELL 6S/10W-6L2, S B B & M



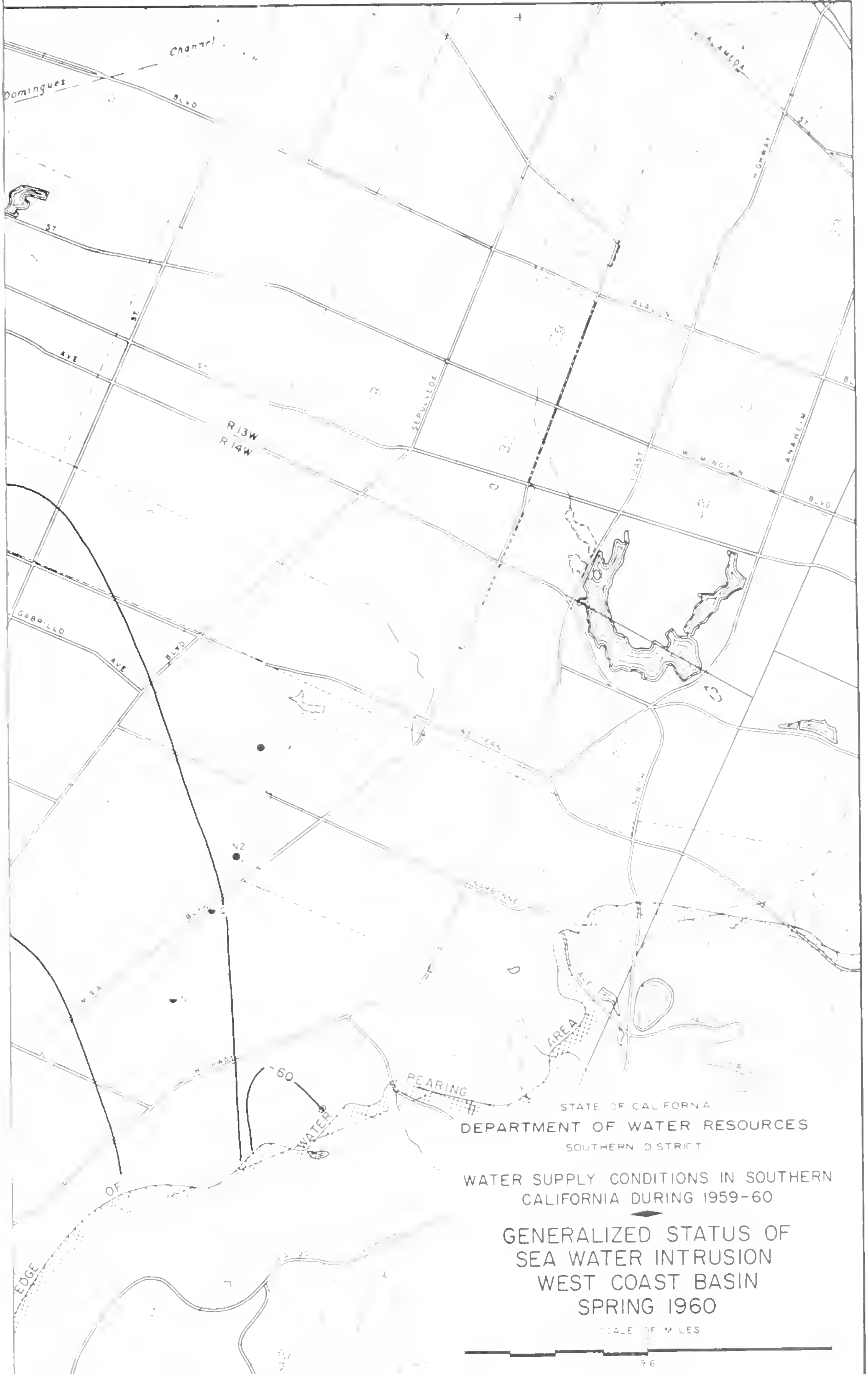
SANTA CLARA RIVER VALLEY (4-400)
OXNARD PLAIN PRESSURE AREA (4-401)
WELL 1N/22W-28A2, S B B & M



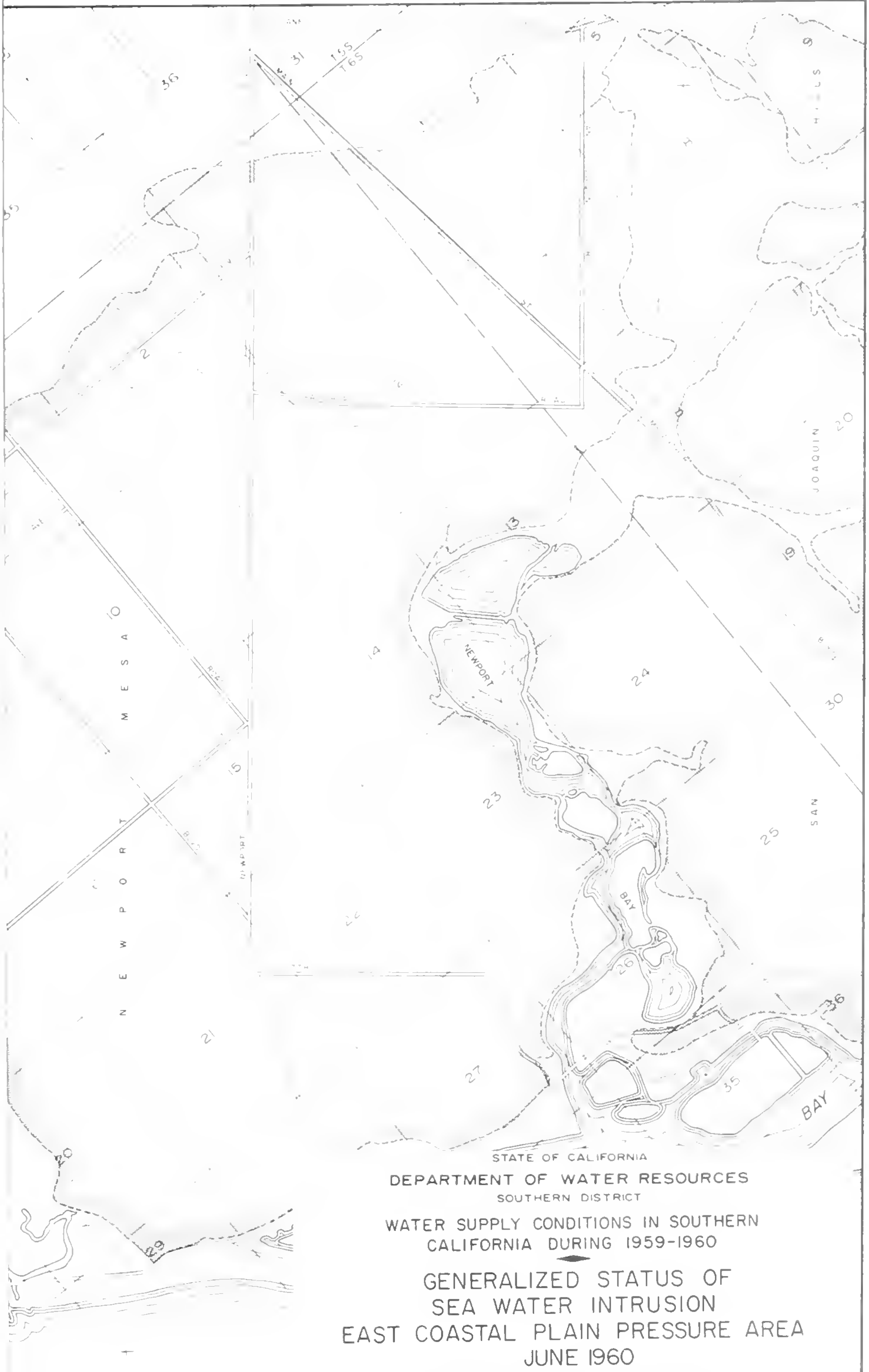
COASTAL PLAIN, LOS ANGELES COUNTY (4-1100)
WEST COAST BASIN (4-1102)
WELL 3S/15W-12H2, S B B & M



FLUCTUATIONS OF CHLORIDE ION CONCENTRATION IN SELECTED WELLS


Dominguez
Channel
BLVD
ALAMEDA
ST
HIGHWAY
AVE
AVALON
SEPULVEDA
R 13W
R 14W
COAST
ANAHEIM
BLVD
GABRILLO
AVE
BLVD
N2
NORTH
AREA
60
EDGE OF WATER
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60
GENERALIZED STATUS OF
SEA WATER INTRUSION
WEST COAST BASIN
SPRING 1960


LEGEND
WELL USED FOR WATER LEVEL CONTROL
WELL USED FOR BOTH WATER QUALITY AND WATER LEVEL CONTROL
LINE OF EQUAL CHLORIDE ION CONCENTRATION
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 1000 PARTS PER MILLION
CULVER CITY
BALLONA GAP
INGLEWOOD
HAWTHORNE
GARDENA
CHARNOCK
FAULT
TORRANCE
EL SEGUNDO
REDONDO BEACH
HERMOSA BEACH
LINE OF INJECTION WELLS
PACIFIC
OCEAN
DEPARTMENT OF WATER RESOURCES
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-60
GENERALIZED STATUS OF
SEA WATER INTRUSION
WEST COAST BASIN
SPRING 1960



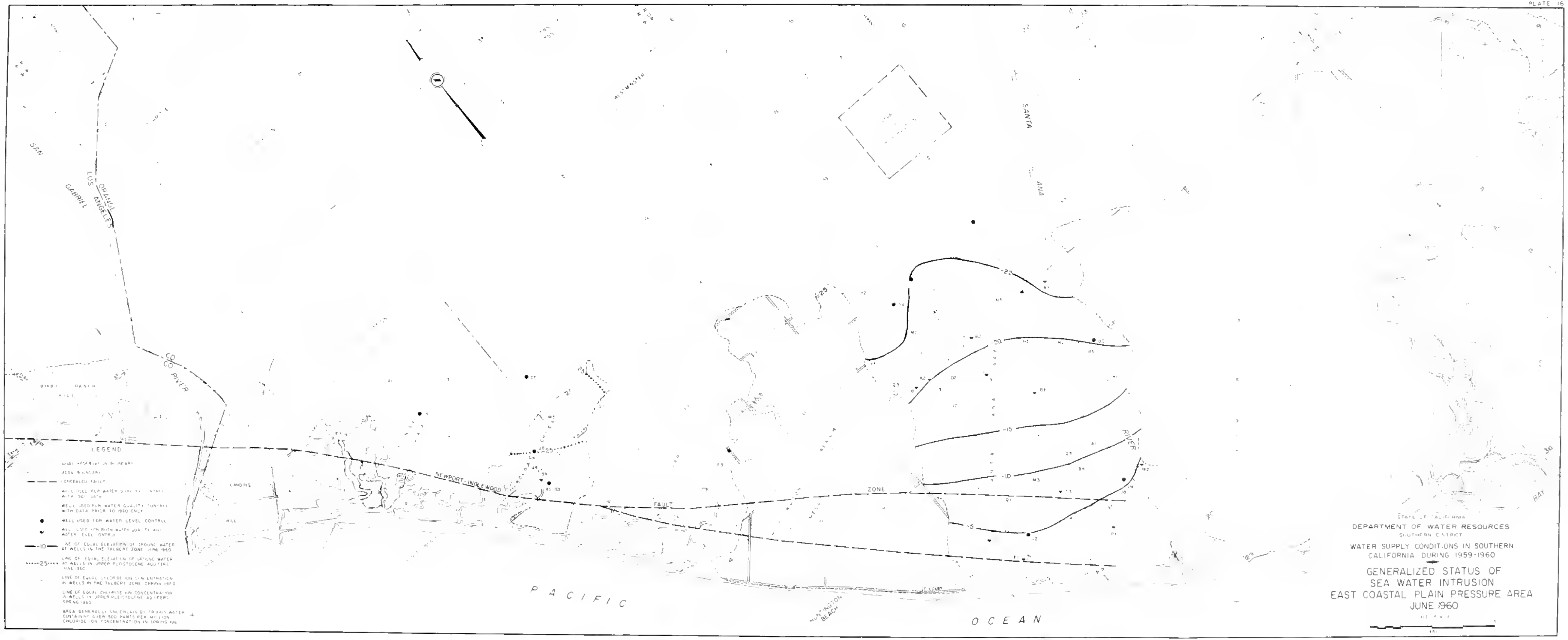
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-1960

GENERALIZED STATUS OF SEA WATER INTRUSION EAST COASTAL PLAIN PRESSURE AREA JUNE 1960

SCALE OF MILES
1 0 2 3

1961


LEGEND
CONCEALED FAULT
WELL USED FOR WATER LEVEL CONTROL
-10- LINE OF EQUAL ELEVATION OF GROUND WATER AT WELLS IN THE TALBERT ZONE JUNE 1960
25 LINE OF EQUAL ELEVATION OF GROUND WATER AT WELLS IN UPPER PLEISTOCENE AQUIFERS JUNE 1960
LINE OF EQUAL CHLORIDE ION CONCENTRATION IN WELLS IN THE TALBERT ZONE SPRING 1960
LINE OF EQUAL CHLORIDE ION CONCENTRATION IN WELLS IN UPPER PLEISTOCENE AQUIFERS SPRING 1960
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 196
SAN GABRIEL
LOS ANGELES
ORANGE
CO. CO.
RIVER
SANTA ANA RIVER
NEWPORT-INGLEWOOD FAULT ZONE
PACIFIC OCEAN
HUNTINGTON BEACH
BAY
WESTMINSTER
LANDING
HILL
-22
-20
-15
-10
-5
25
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1959-1960
GENERALIZED STATUS OF SEA WATER INTRUSION
EAST COASTAL PLAIN PRESSURE AREA
JUNE 1960